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## APPENDIX B CASE STUDIES

Deployment of ITS in Major  
Metropolitan Areas

Adapted From The Intelligent Transportation Infrastructure Deployment Home Page  
(<http://128.169.84.18/cgi-shl/foxweb.exe/c:/website/htdocs/metro/>), updated April 1996

## ALBANY - CAPITAL DISTRICT TRANSPORTATION AUTHORITY (CDTA)

This is a multi-jurisdictional cooperative effort between the cities of Albany, Schenectady, and Troy. The system has an APTS and an incident management components. Advance Public Transportation System - It utilizes a sign post AVL system. The CDTA system is capable of supporting silent alarms, engine component probes, Computer aided dispatching, two-way data communication, electronic fare cards, and an interactive voice response system.

Incident Management Program - I-87/Northway Corridor Incident Management Program - An effort is underway to set up a pilot incident management program on I-87, the Northway in Albany County and southern Saratoga County. Eventually, this program would be expanded to the rest of the expressway system (I-90, I-787, I-890, and more of I-87) in the area.

## AUSTIN

Centralized Traffic Signal Control System - City of Austin -Toomey Road - This is computerized signal control system that controls over 600 traffic signals in the Austin metropolitan area.

- Communication infrastructure is based on twisted pair cable.
- Signal control is based on a distributed system using the Wapitti software with enhancements for emergency vehicle preemption through Model 170 controllers.
- Traffic data and information are collected through inductive loops.
- Traffic information is distributed using Dynamic Message Signs.

Incident Management Program - A Courtesy Patrol will be implemented in 1997. When a freeway operations center becomes operational, the Courtesy Patrol will be integrated with that center.

## ATLANTA - ADVANCED TRANSPORTATION MANAGEMENT SYSTEM

The Atlanta ATMS is a multi-jurisdictional system that technologically and operationally integrates the transportation system in the Atlanta metropolitan region. The Atlanta ATMS consists of a Transportation Management Center operated by the State, six (6) Transportation Control Centers operated by local agencies, a Transit Operation Center operated by MARTA, and an Electronic Toll Collection Facility operated by the State. Deployed systems consist of:

Freeway Management System - The FMS incorporates techniques such as ramp metering, traffic detection/data collection systems, incident detection and management, traffic surveillance, traveler information system, and integrated transit and traffic operations all supported by a comprehensive communication infrastructure. Technologies used include:

- Communication infrastructure consisted of fiber optic, coaxial cable, twisted pair cable, and microwave radios.
- Traffic information collection is done using inductive loops, CCTV cameras, CCTV cameras with VIDS, slow scan CCTV, radar detectors, and surveillance aircraft
- Traffic information distribution is done using DMS, HAR, information Kiosks, Cable TV, telephone information, and personal computers and Internet.

Incident Management Program - This program coordinates the operations of the State and local DOT, State and local fire, police and EMS services, wrecker companies, and media in the 10 county region of metropolitan Atlanta. The incident management program is an integral part of the regional ATMS and shares many of the technologies common to other components. Various techniques used in the operation of this program include the use of state-of-the-art software, hardware and communication system to assist in automated incident detection, verification and response on over 50 miles of freeway, coordination of effort required across all agencies and jurisdictional boundaries, and the Highway Emergency Response Operator program (HERO) which utilizes trained staff and customized emergency response vehicles to quickly respond and locally manage the incident.

Traffic Signal Control System - This system allows the State and local agencies to coordinate their traffic signal control strategies to maximize throughput while minimizing delay and to provide for dynamic control of the signals to respond to major shifts in demand due to incidents or special events.

- Communication infrastructure consisted of fiber optic, coaxial cable, twisted pair cable, and microwave and spread spectrum radios.
- Signal control equipment include various manufacturers of NEMA and Model 170.
- Signal control software include various NEMA and Model 170 closed loop software and a central software to later be incorporated in the ATMS software housed at the TMC and all TCCs.
- Traffic information collection is done using inductive loops, CCTV cameras, CCTV cameras with VIDS, and slow scan CCTV.
- Traffic information distribution is done using DMS, HAR, information Kiosks, Cable TV, telephone information, and personal computers and Internet.

Advance Public Transportation System - The Metro Atlanta Rapid Transit Authority (MARTA) TMS GPS-based system is installed on 250 of its approximately 750 buses. The AVL will hook into both their existing CAD system and bus information kiosks located at MARTA rail transit stations. In addition to kiosks, AVL information will be sent to 15 new passenger information devices at busy bus stops

(which will tell passengers whether each bus is on-time or delayed), and 100 vehicles will be equipped with audible "next-stop" enunciators and visual, digital "next-stop" signs. There will be APCs on 15 of the buses, although the passenger load information will be used for planning purposes only, and will not be available in real time. MARTA is also planning to link the AVL into a separate signal pre-emption project. Finally, the system will include a fiber-optic link to the Georgia DOT's TMC and advanced transportation management system. This link would provide complete transit and traffic information, video feeds, and trip itinerary planning. The AVL system provides real-time vehicle status information to the itinerary planning system. This capability will enable the trip planning system to provide itineraries based on actual vehicle arrivals and departures as well as providing information on service disruptions. The Passenger Routing and Information System (PARIS) will support MARTA's customer information center and kiosks that are available. PARIS requires an origin and destination to produce a nearest bus stop-to-nearest bus stop itinerary. In, addition, a limited amount of highway-related information can be obtained from PARIS.

Electronic Toll Collection System - The system deployed on 6 mile segment of GA 400 utilizes an ETC system that uses an IC card that communicates with the toll facility through the over-the-lane antennae which transmit a focused beam. The system does employ an AVC and VES.

## BALTIMORE

### Freeway Management Center

SHA Traffic Operations Center (TOC) Golden Ring Mall Current coverage with current deployment: 400 miles Baltimore Beltway (I-695), I-95 north & south of I-695, I-83, I-795, MD-295, and various arterials around the Baltimore metropolitan area. Current deployment is loose (i.e. equipment is very far apart) Future coverage with future deployment: 400 miles (same routes as current coverage), with much closer deployment of equipment (1/2 - 1 mile detection spacings and 1 - 2 mile CCTV spacings on some routes and interstates. The primary function of this Traffic Operations Center is incident management.

Technologies used include:

- Communication Infrastructure includes fiber optics and leased telephone lines.
- System capabilities include: real time data collection, electronic incident verification and lane use control.
- Traffic information collection is done using inductive loops, CCTV cameras, cellular phone, CB Radio, wide area radar detector, and slow scan CCTV and service patrol.
- Traffic information distribution is done using DMS, HAR, information Kiosks, Commercial radio stations, telephone information, and personal computers and Internet.

## Statewide Operations Center (SOC)

1000 miles Current coverage: This center provides coverage for the areas of the state that are not currently covered by the other TOC's; as well as control for the other TOC's areas when they are not in operation. This center is built to accommodate any future growth in the state's ATMS program.

- Communication Infrastructure includes fiber optics and leased telephone lines.
- System capabilities include: real time data collection, electronic incident verification and lane use control.
- Traffic information collection is done using inductive loops, CCTV cameras, cellular phone, CB Radio, wide area radar detector, slow scan CCTV, and service patrol.
- Traffic information distribution is done using DMS, HAR, information Kiosks, Commercial radio stations, telephone information, and personal computers and Internet.

Incident Management Program: Chesapeake Highway Advisories Routing Traffic (CHART)

All state routes: 400 miles in Baltimore metropolitan area, 400 miles in Washington metropolitan area, 1000 miles throughout the state, not in Baltimore or Washington metropolitan areas, are covered under this program. The program is managed and supervised by the State DOT and utilizes the same resources as that of the SOC and SHA TOC.

Centralized Traffic Signal Control System: Baltimore DPW - Trans. Engineering Div.

This system is managed by the City of Baltimore and controls over 930 signalized intersections.

- Communication infrastructure is based on coaxial cable.
- Signal control is based on a centralized system using a proprietary interval based system developed by TRW and custom designed CCT controllers.
- Traffic data and information are collected through inductive loops.

Advanced Public Transportation System: Maryland Mass Transit Administration

This system is supervisory system for the City of Baltimore transit system and operates over 930 buses. The system boasts a comprehensive package of technologies for public transportation to provide capabilities such as:

- Passenger information system,
- Real-time rideshare matching,
- Integrated fare media,
- Automatic Passenger Counters,

- Automatic Enunciation System,
- Silent Alarm System,
- Two-way data communication,
- Computer Aided Dispatching, and
- GPS based AVL system.

Electronic Toll Collection System: Susquehanna Bridge

This system is used on US-40 across Susquehanna River. It is a tag-based system using focused beam antennae.

## BOSTON, LAWRENCE, SALEM

Freeway Management Center: Regional Traffic Operations Center

A Temporary Traffic Operations Center (TOC) has been in operation since 11/15/95 on the 8 miles of the Southeast Expressway. This facility was installed in conjunction with a moveable barrier counter follow HOV lane. The operations of the Temporary TOC will be transferred to the Region TOC, once it has been constructed. A Regional TOC is currently under design to be collocated with the State Police Facility in Framingham. This center will be operational in approximately 2 years and will monitor 52 miles of freeways. Field equipment which includes inductive loops, overhead radar detectors, CMS, and CCTV are also under design with an incident management focus.

Although the system is currently under design and construction, the completed system will have:

- Communication architecture and infrastructure is currently under design.
- System capabilities include: real time data collection, electronic incident detection and verification.
- Traffic information collection is done using inductive loops, CCTV cameras, call boxes, cellular phone, CB Radio, radar detector, vehicle probes, and service patrol.
- Traffic information distribution is done using DMS, HAR, information Kiosks, Commercial radio stations, and personal computers and Internet.

Incident Management Program: Boston Metropolitan Area Incident Management Program

This program covers the Boston Metropolitan Area including I-95/Route 128 and I-93. It is managed through the Regional TOC and utilizes the same resources as outlined above.

Centralized Traffic Signal Control System: Boston Traffic Department

The City of Boston computerized Traffic Control System operates 320 intersections in the downtown CBD.

- Communication infrastructure is based on twisted pair cable.
- Signal control is based on a centralized architecture using a UTCS system that allows for TR, TOD, and transit vehicle preemption using NEMA controllers.
- Traffic data and information are collected through inductive loops.

Advanced Public Transportation System: Massachusetts Bay Transportation Authority (MBTA)

This system operates over 900 buses and communicates with the vehicles using a Computer Aided Dispatching. Also, it incorporates a passenger information system with an integrated fare media.

Electronic Toll Collection System

3rd Harbor Tunnel - This system is a tag-based system using MFS Network Technologies and Texas Instrument hardware and software.

Callahan & Sumner Tunnels - MFS Network Technologies is currently designing the ETTM system for the Massachusetts Turnpike Authority.

## BUFFALO, NIAGARA FALLS

Freeway Management Center: NITTEC Traffic Operations Center

The Traffic Operations Center will have electronic surveillance over 50 miles of freeways.

- Communication Infrastructure includes telephone lines, radio and cellular phone.
- System capabilities include: real time data collection, electronic incident detection and verification.
- Traffic information collection will be done using inductive loops, cellular phone, CB Radio, surveillance aircraft, and service patrol.
- Traffic information distribution will be done using DMS, HAR, Commercial radio stations, and cable TV.

Incident Management Program: Western New York Incident Management Team

The WNYIMT has a Clear Road Policy which applies to expressways in the urban area, approximately 50 miles. The program will share the same resources as NITTEC as outlined above.

## Advanced Public Transportation System

### Niagara Frontier Transportation Authority

This system operates over 370 buses and employs an AVL system. It allows for two-way data communication, automatic enunciation system.

### Metro (Buffalo, NY)

This system operates 355 buses and employs a GPS based AVL system. The system will have a passenger information system, a silent alarm system, engine component probes, and Computer Aided Dispatching.

### Electronic Toll Collection System: New York State Thruway

The Niagara Section of the NYS Thruway (I-190), including the North Grand Island Bridge, the South Grand Island Bridge and the sections between Buffalo and Pennsylvania, and Buffalo and Syracuse, have Electronic Toll Collection. The system is a tag-based Mark IV system that utilizes overhead antennae.

## CHARLOTTE, GASTONIA, ROCK HILL

### Freeway Management Center: Congestion Avoidance and Reduction for Autos and Trucks (CARAT)

Detection and surveillance equipment along a 15.2 mile segment of I-77 from the South Carolina state line to Sunset Road. Although, portions of this system are currently under design, the completed system is expected to have the following technologies and capabilities.

- Communication Infrastructure includes fiber optics, microwave radio, and dial up telephone lines.
- System capabilities will include: real time data collection, electronic incident detection and verification and lane use control.
- Traffic information collection is done using inductive loops, CCTV cameras, CCTV cameras with VIDS, cellular phone, CB Radio, and service patrol.
- Traffic information distribution is done using DMS, HAR.

### Incident Management Program

Motor Assistance Patrol responds to over 12,000 incidents per year, from debris in roadway to accidents. This system utilizes many of the same resources and technologies used by CARAT.



### Centralized Traffic Signal Control System: Charlotte Traffic Signal Control Center

The City of Charlotte operates a centralized signal control system in the central business district, and 24 distributed systems on other arterials. The centralized system controls signals at 130 intersections using a DEC MicroVAX II with UTCS software, and twisted pair cable. The city currently operates 24 distributed systems and is designing 2 more. These systems controls a total of 280 intersections. All the staff members can access the distributed systems from their desktop PCs. The distributed systems utilized telephone dial-up communication.

- Communication is accomplished using twisted pair cable, and dial up modems over telephone lines.
- Signal control equipment include various manufacturers of NEMA and older UTCS controllers.
- Signal control software include Traconet closed loop software as well as a UTCS that include transit and EMS preemption capabilities.
- Traffic information collection is done using inductive loops, CCTV cameras, microwave detectors, and Autoscope.
- Traffic information distribution is done using DMS, and lane use signals.

## CHICAGO, GARY, LAKE COUNTY

### Freeway Management Centers

#### IDOT Traffic Systems Center

136 centerline miles Covering portions of the following expressways: Edens I-94 John F. Kennedy Expressway I-90 & I-94 Dan Ryan Expressway I-90 & I-94 Dwight D. Eisenhower Expressway I-290 Adlai E. Stevenson Expressway I-55 Calumet Expressway I-94 I-57 Kingary Expressway I-80 & I-94 Lake Shore Drive US 41 Elginn-O'Hare Expressway None of the tollways are covered. In 1997 electronic surveillance will be expanded to include a total of 153 miles.

- Communication Infrastructure includes fiber optics and twisted pair cable.
- System capabilities include: real time data collection, electronic incident detection and verification, lane use control, traffic responsive signal control, and ramp metering.
- Traffic information collection is done using inductive loops, CCTV cameras, video imaging detectors, ultrasonic detectors, cellular phone, CB Radio, vehicle probes and service patrol.
- Traffic information distribution is done using DMS, HAR, information Kiosks, cable TV, commercial radio stations, telephone information system, cellular telephone, pager service, personal computers and the Internet.

#### INDOT Traffic Management Center

3 miles of freeway on westbound Borman Expressway (I-80, I-94) from Burr St. to Kennedy Ave. is covered by this system.

- Communication Infrastructure includes Spread Spectrum Radio and analog radio.
- System capabilities include: real time data collection, electronic incident detection and verification, expert system/decision support system, and predictive mode.
- Traffic information collection is done using inductive loops, CCTV cameras, cellular phone, CB Radio, vehicle probes, GPS units, service patrol, and roadside weather stations.
- Traffic information distribution is done using DMS and HAR.

#### Incident Management Program: Illinois Emergency Traffic Patrol ("Minutemen")

This program covers Interstate Highways I-90, I-94, I-190, I-290, I-55, I-57, I-80 in the Chicago area covering 89 miles. The Emergency Patrol Vehicles (EPV's) are equipped for and the Minutemen are trained to handle most traffic incidents likely to occur on Chicago-area expressways, including; accidents, disabled vehicles and small fires. The service is termed emergency because assistance is directed toward actual emergencies and hazardous situations. Though help is provided to remove or reduce the exposure to high-volume, high-speed traffic, towing is only provided to relocated vehicles to shoulders or frontage roads, the motorist or police must arrange for towing from there. The patrol fleet includes 35 EPV's, 9 light 4x4's, 3 heavy duty tows, 1 crash crane, 1 tractor-retriever, 1 sand spreaders, 1 heavy rescue and extrication truck, and 4 trailer mounted changeable message signs. The average time to clear an incident varies based on the number of lanes block. The following list shows average clearance times for 1995. No lanes blocked: 9 minutes 1 lane blocked: 12 minutes 2 lanes blocked: 24 minutes 3 or more lanes blocked: 40 minutes Exit ramp blocked: 10 minutes Entrance ramp blocked: 12 minutes.

#### Hoosier Helpers

This program cover Frank Borman Expressway (I-80, I-94) from Indiana/Illinois State Line to I-90 (16 miles) I-65 from US30 to Borman Expressway (I-80, I-94) (6 miles). It responds to nearly 7000 incidents annually.

#### Centralized Traffic Signal Control System: City of Chicago

This system is responsible for monitoring and control of 1068 signalized intersections under the SCATS system.

#### Advanced Public Transportation Systems

##### PACE

This system operates 600 buses and has deployed an operational test of the Automatic Passenger Counters (APC).

### Chicago Transit Authority (CTA)

The completed system (installation began March 1995) will include a GPS-based AVL, advanced communications, computer aided dispatch & schedule management, automated control of on-vehicle and roadside signs, electronic fare payment, and Automatic Passenger Counters. The initial installation will equip 1,558 buses. The remaining buses are scheduled to be replaced with new buses which will have the new equipment.

### Electronic Toll Collection Systems

#### Tri-State Tollway

82 miles of toll facility is under the authority of the Tri-State Tollway. The Tri-State Tollway has Electronic Toll Collection on approximately 50% of the total mileage. The ETC system is a tag-based, AT Comm. system that communicates to overhead antennae.

#### Indiana East-West Toll (I-90)

This system covers 21.3 miles on I-90 From Illinois line To Porter County line (Gary) 135.5 miles on I-90 From Porter County line (Gary) to Ohio state line. This is a tag-based MARK IV system that is expected to be operational in 1998.

#### East-West Tollway

I-88 From US-80 TO I-290 Eisenhower Expressway Transponder at York Rd Plaza WB only. Tag-based system using AT Comm. and MARK IV.

#### North-South Tollway

I-355 From I-55 at Bolingbrook To Army Trail Rd Transponder for the entire route NB & SB. Tag-based system switching using AT Comm. and MARK IV.

## CINCINNATI, HAMILTON

### Freeway Management Center: Cincinnati ARTMIS

The system covers I-71, I-75, I-77, I-275, SR-562, and Cross County Highway in the Cincinnati and Hamilton County Area. Incident management is a component of the FMS operated at the Center.

- Communication Infrastructure includes fiber optics, coaxial cable, twisted pair cable, and Spread Spectrum Radio.
- System capabilities include: real time data collection, electronic incident detection and verification, Freeway-Arterial Coordination System, and ramp metering.

- Traffic information collection is done using inductive loops, CCTV cameras, video imaging detectors, wide area radar detectors, cellular phone, CB Radio, vehicle probes, surveillance aircraft, and service patrol.
- Traffic information distribution is done using DMS, HAR, non-cable TV reports, telephone information system, personal computers and the Internet.

Centralized Traffic Signal Control System: Traffic Control Center

This system maintained and operated by the City of Cincinnati controls 80 signals under a centralized UTCS system, and using model 170 signal controllers.

Advanced Public Transportation System: Southwest Ohio Regional Transit Authority (SORTA)

This system operates 379 buses and has deployed a GPS-based AVL system. The system is operated through a transit operators software and provides for two-way data communication. There will be on-board automatic enunciators and way-side and passenger information system and information kiosks.

## CLEVELAND, AKRON, LORAIN

Advanced Public Transportation System: Laketran

Laketran operates 17 buses and 53 paratransit buses. Design of a new computer system to provide AVL, two-way data communications, and passenger information has began. The passenger information system will be an Interactive Voice Responsive telephone information service.

Electronic Toll Collection System: Ohio Turnpike

This 219 miles toll facility utilizes ETC based on a closed system type on I-80 and I-90 from junction of I-76 west to Indiana line.

## COLUMBUS

Freeway Management Center: Columbus Freeway Operations Center

Ultimate build out is 115 miles. The routes are I-71, I-70, I-270, I-670, SR-325, SR-104, and US-33. Incident management is performed by incident response teams.

- Communication Infrastructure includes fiber optics, coaxial cable, and twisted pair cable.
- System capabilities include: real time data collection, electronic incident detection and verification, and ramp metering.

- Traffic information collection is done using inductive loops, CCTV cameras, call boxes.
- Traffic information distribution is done using DMS, information kiosks, cable TV, commercial radio stations, and telephone information system.

Centralized Traffic Signal Control System: Columbus Traffic Signal System

City of Columbus is responsible for maintaining over 400 traffic signals.

- Communication infrastructure is based on fiber optics, coaxial, and twisted pair cable.
- Signal control is based on a centralized UTCS (Computran) and a closed loop distributed system (Econolite) using NEMA controllers.
- Traffic data and information are collected through inductive loops and radar detectors.
- Traffic information is distributed using commercial radio stations.

Advanced Public Transportation System: Central Ohio Transit Authority

This Authority operates over 340 buses and has deployed a test bed of 30 Automatic Passenger Counters and transit traveler telephone information number.

## DALLAS, FORT. WORTH

### Freeway Management Centers

TXDOT Satellite Operations Center (SOC) - Fort Worth

The Satellite Operation Center (SOC) is an interim control center. The TRANSVISION traffic management center is scheduled to open in 1998, at which time there will be approximately 80 freeway miles under surveillance. The SOC is currently monitoring I-35W from Alta Mesa Blvd. to I-30: 5 miles I-20 from I-35W to I-20/I-820 split: 8 miles.

- Communication Infrastructure includes fiber optics, twisted pair cable, microwave radio, dial up telephone lines, digital T1 telephone lines, and ISDN lines.
- System capabilities include: real time data collection, electronic incident detection and verification, lane use control, and ramp metering.
- Traffic information collection is done using inductive loops, CCTV cameras, video imaging detectors, cellular phone, and service patrols.
- Traffic information distribution is done using DMS, information kiosks, television stations, commercial radio stations, telephone information system, and personal computers and the Internet.

Incident management for the area is provided by courtesy patrol in the Fort Worth area on I-820, I-30, I-35W, US-287, I-20, SH-183, and SH-360 (approximately 150 miles).

#### Transportation Management Satellite - Dallas

The Dallas Area Transportation Management Satellite is currently under construction. The completed system with monitor and control operations on I-635 from I-35E east to I-75 I-75 from Woodall Rodgers Freeway north to I-635 I-35E from SR12 north to I-635 SR 12 from SR183 north to I-35E SR183 from SR97 east to I-35E.

- Communication Infrastructure includes fiber optics, Spread Spectrum Radio, telephone lines, and ISDN lines.
- System capabilities include: real time data collection, electronic incident detection and verification, lane use control.
- Traffic information collection is done using inductive loops, CCTV cameras, video imaging detectors, scanners, cellular phone, CB radio, vehicle probes, and service patrols.
- Traffic information distribution is done using DMS, HAR, information kiosks, video link to television affiliates, telephone information system, and personal computers and the Internet.

An informal Incident Management Program has been started with the TxDOT, Dallas Police Department, and other Dallas County and City Police Departments to inform TxDOT over police radios of major incidents.

#### Centralized Traffic Signal Control System

##### City of Fort Worth - Traffic Control Management Center

Existing system installed in 1987 (Frederic R. Harris, Inc.) coordinates/monitors 240 signalized intersections, 140 CBD, 40 on coordinated arterials and 60 on isolated intersections. Upgrade and expansion of system is currently underway.

- Communication infrastructure is based on coaxial, and twisted pair cable.
- Signal control is based on a distributed / closed loop distributed systems using NEMA and model 170 controllers.
- Traffic data and information are collected through inductive loops and CCTV cameras.

##### City of Dallas - Traffic Management Center

The City of Dallas operates more than 1200 traffic signals, over 500 of these are presently connected to the system.

- Communication infrastructure is based on fiber optics, coaxial, microwave radio, and twisted pair cable.
- Signal control is based on a distributed systems using the BiTrans and ESCORT Sonex software with NEMA and model 170 controllers.
- Traffic data and information are collected through inductive loops and radar detectors.

#### City of Garland

The City operates over 104 signalized intersections.

- Communication infrastructure is based on twisted pair cable.
- Signal control is based on a distributed systems using the Zone Monitor IV by Econolite, with NEMA controllers.
- Traffic data and information are collected through inductive loops.

#### City of Plano

The City operates over 96 signalized intersections.

- Communication infrastructure is based on coaxial cable.
- Signal control is based on a centralized architecture using RMEA signal software, with model 179 controllers.
- Traffic data and information are collected through inductive loops.

#### City of Richardson Signal System

The City operates over 96 signalized intersections.

- Communication infrastructure is based on cable TV, and coaxial cable.
- Signal control is based on a centralized architecture using Naztec signal software, with NEMA controllers.
- Traffic data and information are collected through inductive loops.
- Traffic information distribution are through DMS.

#### Advanced Public Transportation System: Dallas Area Rapid Transit (DART)

This system operates 1300 buses and has deployed a GPS-based AVL system. The system is operated through a transit operators software and provides Computer Aided Dispatching (CAD) and a silent alarm system.

#### Electronic Toll Collection System: Dallas North Tollway

Electronic Toll Collection has been installed on the Dallas North Tollway (From I-35E to I-70) since 1987. Currently there are about 110,000 toll tags distributed. The ETC system is a tag based system by Amtech that communicates via overhead antennae.

Dayton, Springfield

#### Centralized Traffic Signal Control System

City of Kettering

The City operates over 72 signalized intersections.

- Communication infrastructure is based on Fiber optic, microwave radio, and twisted pair cable.
- Signal control is based on a distributed systems using the Smartways software by Transyt, with NEMA controllers.
- Traffic data and information are collected through inductive loops, CCTV cameras and radar detectors.

City of Dayton Signal System

The City of Dayton operates signals at a total of 340 intersections. Of these, 220 operate under a distributed closed loop system. The remainder are fixed time signals.

- Communication infrastructure is based on Fiber optic and twisted pair cable.
- Signal control is based on a distributed systems using the Smartways software by Transyt, with NEMA controllers.
- Traffic data and information are collected through inductive loops.

## DENVER, BOULDER

Freeway Management Center: Colorado TOC

The Colorado Traffic Operations Center monitors highway conditions throughout the state. In Denver 7 miles of I-25, from Mile High Stadium to US 36, are equipped with electronic surveillance.

- Communication Infrastructure includes fiber optics, microwave radio, and twisted pair cable.



- System capabilities include: real time data collection, electronic incident detection and ramp metering.
- Traffic information collection is done using inductive loops, CCTV cameras, call boxes, sonic detectors, and service patrols.
- Traffic information distribution is done using DMS, HAR, information kiosks, cable television, non-cable TV reports, telephone information system, and FAX service to media.

An Incident Management Program has been incorporated in the FMS for this corridor.

## Centralized Traffic Signal Control System

City of Denver

Information about this system was not available at the time of compilation.

City of Aurora

The City operates over 105 signalized intersections. The original system was developed by computran in 1986 and was upgraded by Automatic/Eagle in 1996.

- Communication infrastructure is based on twisted pair cable.
- Signal control is based on a distributed systems using an Automatic/Eagle software, with NEMA controllers.
- Traffic data and information are collected through inductive loops.

City of Lakewood

The City operates over 200 signalized intersections.

- Communication infrastructure is based on twisted pair cable.
- Signal control is based on a centralized architecture using Multisonics VMS-330, with NEMA controllers.
- Traffic data and information are collected through inductive loops.

Advanced Public Transportation System: Regional Transportation District

The Regional District recently has completed installation of a Transportation Management Solutions (TMS) GPS-based system on all of its 900 buses. Each dispatcher is provided with two large monitors, one of which shows a digital map of Denver (or user-defined enlargement of part of the area) along

with the location of each bus with which he is concerned. the buses are color-coded, based on status: on-time, early, late, or emergency-alarm-activated. The other dispatcher screen includes a number of utilities, including a record of radio traffic, and incident reports. Drivers are provided with a small control "head," through which they may send and receive messages, including automatic reports of their on-time status. Also information is transmitted to dispatchers regarding bus engine idling. In Denver, it is unlawful for buses to idle their engines for over 10 minutes. The AVL is principally used for ensuring schedule adherence, making real-time adjustments in response to service disruptions, response to emergencies, and scheduling. In addition, the AVL will be used to update in real time the departure-time monitors at the downtown terminals. There also are future plans to feed AVL information directly into the telephone information system. The system also provides for Computer Aided Dispatching (CAD), two-way data communication, and the use of electronic fare cards.

#### Electronic Toll Collection System: E-470

The ETC system is deployed on a 5 mile segment of E-470 from I-25 to SH 83. This system is tag based system by XCI that communicates via overhead antennae.

## DETROIT, ANN ARBOR

#### Freeway Management Center: Michigan Intelligent Transportation Systems Center

The system currently covers a 33 miles of freeway and state routes on I—75, I-94 and M-10 32.5 miles that will be expanded in the future to 250 miles.

- Communication Infrastructure includes microwave radio, fiber optics, coaxial, and twisted pair cable.
- System capabilities include: real time data collection, electronic incident detection and verification, and ramp metering.
- Traffic information collection is done using inductive loops, CCTV cameras, video image detectors, and service patrols.
- Traffic information distribution is done using DMS and HAR.

An Incident Management Program has been incorporated in the FMS for All of Southeast Michigan freeways, approximately 250 miles.

#### Incident Management Program: FAST-TRAC

Oakland County - including portions of M-59, I-696 and I-75. I-96 (as part of MDOT's program.) Approximately 2500 miles of roadway are under surveillance.

### Centralized Traffic Signal Control System: Oakland County Traffic Operations Center

Oakland County is responsible for the operation and maintenance of over 500 traffic signals. The existing system was implemented in 1992 by Roads and Traffic Authority of New South Wales.

- Communication infrastructure is based on telephone lines.
- Signal control is based on a distributed systems using an the SCATS software, with SCATS-NEMA controllers.
- Traffic data and information are collected through inductive loops, CCTV cameras and video imaging detectors.
- Traffic information distribution is done through the FAST-TRAC system and the TV Traffic Channel.

### Advanced Public Transportation Systems

#### Suburban Mobility Authority for Regional Transit (SMART)

SMART operates over 400 buses that also act as probes for MDOT freeway monitoring. The GPS-based AVL system allows for engine component probes, silent alarm system, Computer Aided Dispatching, and two-way data communication. The passenger information system, will have an automated telephone help service and information kiosks.

#### Ann Arbor Transportation Authority

The Authority operates 80 buses using a GPS-based AVL system. Some of the system capabilities include: Engine component probes, silent alarm systems, two-way data communication, integrated fare media, electronic and automated trip payment, multi-provider reservation and integrated billing, automatic enunciator, GPS-based next stop message, and automatic demand responsive dispatching.

#### City of Detroit Department of Transportation

The current system capabilities are limited to automated telephone help services. The City of Detroit is in the process of upgrading the system. The upgraded system will included items such as Automatic Vehicle Location, Voice Enunciation System, and Information Kiosks. The system is expected to be implemented by the summer of 1997.

### Electronic Toll Collection Systems

#### Ambassador Bridge

The Automatic Vehicle Identification (type 3 transponders) technology which will be install at the Ambassador Bridge will provide Electronic Toll Collection and Automatic Customs Clearance of commercial vehicles. This system is part of the Advantage I-75 Project. There are discussions with the

Michigan Department of Transportation to link the Ambassador Bridge AVI systems with the Michigan Intelligent Transportation Systems Center.

#### Windsor Tunnel

Windsor Tunnel (SR-3) is a two mile toll facility that utilizes a tag based Mark IV system that communicates with the in-pavement antennae.

## EL PASO

#### Freeway Management Center: El Paso Freeway Management Center

This system covers 65 miles of freeway on I-10: 27 miles US 54: 8 miles I-375: 30 miles.

- Communication Infrastructure includes fiber optics, coaxial, and twisted pair cable.
- System capabilities include: real time data collection, electronic incident detection and verification, lane use control, and ramp metering.
- Traffic information collection is done using inductive loops, CCTV cameras, two-way radio, and service patrols.
- Traffic information distribution is done using DMS.

#### Centralized Traffic Signal Control System: Traffic Management Center

The City of El Paso controls over 260 signalized intersections. The initial capital construction cost of the current system (by Sperry Rand, 1982) was \$2,500,000, the system which is currently in design will cost \$3,000,000.

- Communication infrastructure is based on twisted pair cable.
- Signal control is based on a centralized and a distributed architecture using a UTCS and a yet to be determined software, with NEMA and model 170 controllers.
- Traffic data and information are collected through inductive loops and video imaging detectors.
- Traffic information distribution is done through DMS.

#### Advanced Public Transportation System: Sun Metro

This system operates 222 buses and is designing a GPS-based AVL system that incorporates Automatic Passenger Counters, silent alarm system, and Computer Aided Dispatch (CAD.)

## FRESNO

Freeway Management Center: Central Valley Transportation Management Center

This system monitors 347 miles of freeway on I-5 FROM Lebec, CA TO SR 152 182 miles SR 99 FROM I-5 TO SR 152 165 miles.

- Communication Infrastructure is based on telephone lines.
- System capabilities include: real time data collection and ramp metering.
- Traffic information collection is done using inductive loops, CCTV cameras, cellular phone, and service patrols.
- Traffic information distribution is done using DMS and HAR.

Centralized Traffic Signal Control System: Fresno

Caltrans District 6 includes signalized intersections in Madera, Fresno, Kings, Tulare, and kern Counties. Currently, Caltrans is monitoring systems in Madera, Fresno, and Tulare Counties.

These systems include: Madera 5 signals Aug/1992 Fresno 21 signals Nov/1994 Tulare 24 signals Dec/1993

- Communication infrastructure is based on fiber optic and twisted pair cable.
- Signal control is based on a distributed system using the Quicnet by BiTran software, with model 170 controllers.
- Traffic data and information are collected through inductive loops, magnetic probes, and video imaging detectors.

## GRAND RAPIDS

Centralized Traffic Signal Control System: Grand Rapids Signal System

This system covers 230 signalized intersections in Grand Rapids and portions of Walker, Wyoming, Kentwood, and surrounding townships. The existing system was developed by Sperry in 1981 and is being upgraded at this time. (limited information is available in regard to the upgraded design)

- Communication infrastructure is based on fiber optic (in design) and coaxial cable (existing).

- Signal control is based on a centralized architecture using a UTCS (existing) and the Eagle (in design) software, with NEMA controllers.
- Traffic data and information are collected through inductive loops.

## GREENSBORO, WINSTON-SALEM, HIGH POINT

### Freeway Management Centers

#### Winston-Salem Freeway Management Center

This system cover over 41 miles of freeway on US 52 - From I-40 to University Parkway (9miles) I-40 - From NC 801 tto Union Cross Road (22 miles) Business 40/US 421. The freeway management center will use the loop detectors to evaluate the effectiveness of the changeable message signs. Other government agencies will have software which will allow them to access traffic data via a modem. This system was in the design stage at the time of this document's preparation. Technologies that are listed below are to be deployed.

- Communication Infrastructure is based on fiber optic, twisted pair cable, radio, and leased telephone lines.
- System capabilities include: real time data collection, electronic incident detection and verification, lane use control, and ramp metering.
- Traffic information collection is done using inductive loops, CCTV cameras, cellular phone, CB radio, surveillance aircraft, and service patrols.
- Traffic information distribution is done using DMS, HAR, commercial radio stations, FAX service to media, and personal computers via modem.

#### Greensboro Freeway Management Center

This system cover 27 miles of freeway on I-40 at High Point Road: 0.75 miles I-40/1-85 corridor: 20 miles I-87 corridor: 3 miles I-40 corridor: 13 miles. Currently there are two video surveillance cameras near I-40 at High Point Road, primarily to view interchange. The Greensboro city DOT has four additional cameras on the city coliseum facility used to monitor special event traffic. These may also be utilized in emergency conditions, traffic would be detoured along this route. This route also has in place lane control signs and small changeable message boards to operate a reversible lane system. There are in place sixteen overhead variable message signs along I-40/85 from NC 62 in Alamance County to I-85 south at Groometown Road and I-40 to NC 66 in Forsyth County. These are used in conjunction with the incident management program to provide information to the traveling public and to aid in the implementation of detour routes. Future plans of 1996 construction are to install nine video cameras along I-40 from NC 68 to Elm/Eugene Street. These will be used for Incident Management activities in order to monitor traffic conditions, and verification of accident occurrence and location.

- Communication Infrastructure is based on fiber optic and telephone lines.
- System capabilities include: lane use control.
- Traffic information collection is done using CCTV cameras, cellular phone, CB radio, and service patrols.
- Traffic information distribution is done using DMS, HAR, and telephone information system.

## Incident Management Programs

### Forsyth County Incident Management Program

This program is the part of the FMS and covers US 52 - From I-40 to University Parkway (9 miles) I-40 - From NC 801 to Union Cross Road (22 miles) Business 40/US 421.

### Guilford County Incident Management Program

This program is the part of the FMS and covers I-40/I-85 from McConnell Road to I-40/I-85 split (9 miles) I-85 from I-40/I-85 split to Rehobeth Church Road (2 miles) I-40 from I-40/I-85 split to Sandy Ridge Road (11 miles) US 29 from Hicone Road to US 29/I-40/I-85 merge (9 miles). It responds to 840 incidents per year with an average response time of 12 minutes. Centralized Traffic Signal Control System

### Greensboro Traffic Management Center

The City is responsible for operation of over 300 traffic signals. The system and the Center were developed by JHK, NCDOT, and the City.

- Communication infrastructure is based on fiber optic, microwave, radio, and twisted pair cable.
- Signal control is based on a centralized architecture using a UTCS software, with NEMA controllers.
- Traffic data and information are collected through inductive loops and CCTV cameras.
- Traffic information distribution is done using DMS and HAR.

### Highpoint Signal System

The City of High Point currently operates signals at 135 intersections. Of these, 50 are centrally controlled, 50 are controlled by 3 closed-loop arterial systems, and 35 are time base controlled. A new UTCS based central signal control system is in design. This system will replace the existing systems and will control signals at 165 intersections.

- Communication infrastructure is based on twisted pair cable.

- Signal control is based on a closed loop distributed and centralized architecture using a UTCS and a closed loop software, with NEMA an electro-mechanical controllers.
- Traffic data and information are collected through inductive loops.

#### Winston-Salem Traffic Control Center

The Center is responsible for over 300 traffic signals in the area in and near the city limits of Winston-Salem. The system and the center were developed by Kimley Horn and Computran.

- Communication infrastructure is based on fiber optic and twisted pair cable.
- Signal control is based on a distributed architecture using a UTCS software, with NEMA TS-2 controllers.
- Traffic data and information are collected through inductive loops, CCTV cameras, and CCTV cameras with VIDS.
- Traffic information distribution is done using DMS and HAR.

#### Advanced Public Transportation System: Winston-Salem Transit Authority (WSTA)

WSTA operates 17 buses using a GPS-based AVL system that has a silent alarm system, Computer Aided Dispatching (CAD), two-way communications, electronic fare cards, and a telephone information system.

## GREENVILLE, SPARTANBURG

Incident Management Program: Motorist Assistance Patrol This program covers 28 miles of freeway on I-85 in Spartanburg County, 20 miles I-26, 8 miles. The Motorist Assistance Patrol service is available to respond to incidents. Four permanent changeable messages signs have been installed. The Motorist Assistance Patrol operations will be based in the 911 center.

#### Centralized Traffic Signal Control System: City of Spartanburg Traffic Signal Control Center

Currently, in Spartanburg 60 of the 99 signalized intersection are centrally controlled, and 12 more intersections are in designed to be under central control.

- Communication infrastructure is based on twisted pair cable.
- Signal control is based on a centralized architecture using the Transyt Smartways software, with NEMA controllers.
- Traffic data and information are collected through inductive loops.



## HARTFORD, NEW BRITAIN, MIDDLETOWN

Freeway Management Center: Newington Operations Center

The Newington Operations Center monitors 18 miles of freeways and 300 signalized intersections in the Hartford area, and monitors another 100 signalized intersections throughout the state. The 48 personnel, \$3,000,000 budget, and \$30,000,000 capital construction cost includes the Newington Operations Center and the Bridgeport Operations Center.

- Communication Infrastructure is based on leased and dial up telephone lines.
- System capabilities include: real time data collection.
- Traffic information collection is done using CCTV cameras and roadside mounted radar.
- Traffic information distribution is done using DMS, HAR, and telephone information system, and commercial radio stations.

### Centralized Traffic Signal Control Systems

Newington Operations Center

The Center manages over 300 intersection in the Hartford metropolitan area, and another 100 intersections state wide.

- Communication infrastructure is based on twisted pair cable and leased telephone lines.
- Signal control is based on a centralized and a distributed architecture using a UTCS and a closed loop software, with NEMA controllers.
- Traffic data and information are collected through inductive loops.

City of Hartford Traffic Signal System

There are 230 signalized intersection maintained by the City of Hartford, of which 200 are centrally controlled. The system was developed by JHK.

- Communication infrastructure is based on twisted pair cable.
- Signal control is based on a centralized architecture using a UTCS software, with NEMA and model 170 controllers.
- Traffic data and information are collected through inductive loops, CCTV cameras and radar detectors.

#### Advanced Public Transportation System: Connecticut Department of Transportation - Hartford

The Connecticut Department of Transportation operates a total of 370 buses. There are 220 buses in Hartford, 113 in New Haven, and 37 in Stamford. The APTS allows for electronic and automated trip payment.

## HONOLULU

#### Freeway Management Center: Transportation Management System

The Hawaii Department of Transportation (HDOT) intends to coordinate the Traffic Management Center development with the City of Honolulu's system. HDOT is planning to phase 44 miles of surveillance equipment along the interstate over the next 4 years. The system and technologies described below are in the design stage.

- Communication Infrastructure is and will be based on fiber optic.
- System capabilities will include: real time data collection, electronic incident detection and verification, and lane use control.
- Traffic information collection is done using inductive loops, CCTV cameras, and call boxes.
- Traffic information distribution is done using DMS, HAR, commercial radio stations, cable TV, information kiosks, and personal computers and Internet.

#### Centralized Traffic Signal Control System: Honolulu Traffic Management Center

This system operates over 300 traffic signals in the CBD of Honolulu.

- Communication infrastructure is based on fiber optic, microwave radio, and twisted pair cable.
- Signal control is based on a centralized architecture using the Bitrans software, with model 170 controllers.
- Traffic data and information are collected through inductive loops, CCTV cameras, CCTV cameras with VIDS, and microwave detectors.
- Traffic information distribution is done through cable TV.

## HOUSTON, GALVESTON, BRAZORIA

#### Freeway Management Center: Houston TranStar

Although the complete coverage area of the Center is not yet defined it will have monitoring and control capabilities over the freeway and surface street corridors in the area. The system

- Communication Infrastructure is based on fiber optic, coaxial, and twisted pair cables.
- System capabilities will include: real time data collection, electronic incident detection and verification, ramp metering and lane use control.
- Traffic information collection is done using inductive loops, CCTV cameras, video imaging detectors, roadside mounted radars, probe vehicles, and call boxes.
- Traffic information distribution is done using DMS, commercial radio stations, information kiosks, and personal computers via modems and displays at activity centers.

## JACKSONVILLE

Freeway Management Center: Jacksonville Traffic Control Center

The Center is responsible for operation of 113 miles of freeway on I-10 (from I-95 west to I-295) 8.1 miles I-95 (from Exit 128 South to Exit 96) 35 miles I-295 (loop) 70 miles. This system was under design at the time of this document's preparation.

- Communication Infrastructure will be based on fiber optic and microwave radio.
- System capabilities were being determined.
- Traffic information collection is done using CCTV cameras, CCTV cameras with VIDS, call boxes, cellular phone, and service patrols.
- Traffic information distribution is done using DMS, HAR, information kiosks, and telephone information numbers.

Incident management for the center's coverage area is performed by the Jacksonville Freeway Management Team.

Centralized Traffic Signal Control System: Jacksonville Urban Traffic Control Center

The center is responsible for the operation of over 140 traffic signals in the CBD area. The system is under construction in some aspects of the deployed technologies.

- Communication infrastructure is based on fiber optic, and coaxial cable.
- Signal control is based on a centralized architecture using an existing UTCS and the upgraded Bitrans software, with NEMA and upgraded model 170 controllers.
- Traffic data and information are collected through inductive loops.

## KANSAS CITY

### Incident Management Program: Kansas City Regional Incident Management Coalition

The program is responsible for handling of incidents on I-70 State Line TO I-470 I-35 SR 210 TO StateLine I-435 State Line TO US 71 US 71 I-435 TO Main Street. This program responds to over 9,000 incidents annually and boasts a 15 min. average response time and 20 min. average clearance time.

### Centralized Traffic Signal Control Systems

#### Overland Park Traffic Control System

The City of Overland Park is charge of operation of 94 traffic signals.

- Communication infrastructure is based on coaxial cable and telephone lines.
- Signal control is based on a centralized and a distributed architecture using Wapiti/D.M. software, with model 170 controllers.
- Traffic data and information are collected through inductive loops.

#### City of Lenexa, KS

The City of Lenexa presently has 25 signals on fiber optic communications lines (out of a total of 45 signals). They operate by zone master/slave Time of Day plans (6-8 plans). Timing changes, reports and online monitoring is available via TRANSLINK software, and dialup modems. Additional fiber to be added in 1996 will bring 3 more signals online. The intial capitol cost of install the fiber optic communications was \$400,000.

- Communication infrastructure is based on fiber optic cable.
- Signal control is based on a distributed architecture using the TRANSLINK software, with model 170 controllers.
- Traffic data and information are collected through inductive loops and CCTV cameras.

### Advanced Public Transportation System: Kansas City Area Transit Authority

The Authority operates 250 buses using a sign post based AVL system that has a silent alarm system and two-way communications. A passenger information system and information Kiosks are currently under design.

### Electronic Toll Collection System: Kansas Turnpike

The Kansas Turnpike Authority operates electronic toll collection (ETC) on the entire length of the Kansas Turnpike (237.5 miles from Oklahoma to Kansas City, KS). This closed ticketed system, and Amtech Intellitag 2000, was installed in October 1995. To date there are between 42,000 and 43,000 in-vehicle transponders in operation, and 16%-20% of the revenue is from ETC.

## LAS VEGAS

### Freeway Management Center: McCarran Freeway Management System

Monitors 5 miles of freeway on Airport tunnel connector and I-215.

- Communication Infrastructure is based on fiber optic and microwave radio.
- System capabilities will include: real time data collection, electronic incident detection and verification, and lane use control.
- Traffic information collection is done using inductive loops, CCTV cameras, and call boxes.
- Traffic information distribution is done using DMS, HAR, commercial radio stations, cable TV, information kiosks, and personal computers and Internet.

### Centralized Traffic Signal Control System: Las Vegas Area Computer Traffic System (LVACTS)

City of Las Vegas, City of North Las Vegas, and Clark County maintain over 470 traffic signals.

The old system is being upgraded and the technologies listed below describe the system currently under design.

- Communication infrastructure is based on fiber optic, microwave radio, 900 Mhz radio, and twisted pair cable.
- Signal control is based on a centralized and distributed architecture using a UTCS type software, with NEMA and model 170 controllers.
- Traffic data and information are collected through inductive loops, CCTV cameras, and CCTV cameras with VIDS.
- Traffic information distribution is done through DMS and HAR.

## LITTLE ROCK, NORTH LITTLE ROCK

### Centralized Traffic Signal Control System: Traffic Control Center

The system controls over 120 traffic signals in the CBD.

- Communication infrastructure is based on twisted pair cable.
- Signal control is based on a centralized architecture using a UTCS type software, with NEMA and Honeywell 1000 controllers.
- Traffic data and information are collected through inductive loops.

## LOS ANGELES, ANAHEIM, RIVERSIDE

### Freeway Management Centers

#### Los Angeles Transportation Management Center

This system control over 750 miles of freeway including all freeways in Los Angeles and Ventura Counties.

- Communication Infrastructure is based on fiber optic, coaxial cable, microwave radio, dial up, 4 wire data and digital T1 telephone lines.
- System capabilities will include: real time data collection, electronic incident detection, ramp metering and mainline metering.
- Traffic information collection is done using inductive loops, CCTV cameras, CCTV cameras with VIDS, service patrol, and call boxes.
- Traffic information distribution is done using DMS, HAR, cable TV, information kiosks, telephone information system, Traffic Vision, and personal computers and Internet.

#### Orange County Transportation Management Center - Caltrans District 12

The TMC covers the over 260 miles of the following freeways: I-5, I-405, SR 55, SR 73, SR 22, SR 57, SR 91.

- Communication Infrastructure is based on fiber optic, microwave radio, and telephone lines.
- System capabilities will include: real time data collection, electronic incident detection and verification, and ramp metering.
- Traffic information collection is done using inductive loops, CCTV cameras, CCTV cameras with VIDS, CB radio, surveillance aircraft, service patrol, and call boxes.
- Traffic information distribution is done using DMS, HAR, cable TV, California Information Network, information kiosks, and commercial radio stations.

All routes in Orange County are covered by the APID Incident Management Program.

## Centralized Traffic Signal Control Systems

### Los Angeles Automated Traffic Surveillance and Control (ATSAC)

The system developed by JHK and Associates, cover 500 sq. miles of arterial and network street systems includes freeway off-ramp signals.

- Communication Infrastructure is based on fiber optic, coaxial cable, spread spectrum radio, atmospheric laser, and microwave radio.
- Signal control is based on a centralized architecture using a UTCS and ATCS software, with model 170 and 2070 controllers.
- Traffic data and information are collected through inductive loops, CCTV cameras, and magnetometers.
- Traffic information distribution is done through DMS, HAR, telephone information system, personal computers and the Internet, lane use signals, and trailblazers.

### Anaheim Traffic Management Center

The system developed by JHK and Associates control 212 signals in the City of Anaheim. The Anaheim Traffic Management Center has a two-way communications link with the Caltrans District 7 Traffic Operations Center in Los Angeles and the District 12 Office in Orange County.

- Communication Infrastructure is based on fiber optic, coaxial cable, twisted pair cable, and microwave radio.
- Signal control is based on a centralized architecture using a UTCS and soon to be implemented SCOOT system software, with model 170 controllers.
- Traffic data and information are collected through inductive loops, CCTV cameras, and CCTV cameras with VIDS.
- Traffic information distribution is done through DMS, HAR, cable TV, personal computers via modems, and Public Information Database.

### Pasadena Traffic Management Center (TMC)

The system developed by JHK and Associates control 280 signals in the City of Pasadena.

- Communication Infrastructure is based on twisted pair cable and telephone lines.
- Signal control is based on a centralized architecture using a JHK Series 2000 system software, with model 170 controllers.
- Traffic data and information are collected through inductive loops, CCTV cameras, radar detectors, and Autoscope.

- Traffic information distribution is done through DMS and HAR.

#### Long Beach Traffic Management Center

The Long Beach Traffic Management Center controls 281 of the city's 505 signalized intersections using the system developed by Bi-Trans.

- Communication Infrastructure is based on twisted pair cable, radio and microwave radio.
- Signal control is based on a distributed architecture using a PC-based Bi-Trans software, with model 170 controllers.
- Traffic data and information are collected through inductive loops, CCTV cameras, radar detectors, magnetometers and video imaging detectors.

#### ITRAC

The system developed by IDC, FSI, and JHK control 220 signals in the City of Irvine.

- Communication Infrastructure is based on fiber optic, coaxial cable, twisted pair cable and microwave radio.
- Signal control is based on a centralized and distributed architecture using the FSI MIST system with the OPAC software, with NEMA and model 2070 controllers.
- Traffic data and information are collected through inductive loops, CCTV cameras, and CCTV cameras with VIDS.
- Traffic information distribution is done through DMS.

#### City of Santa Ana - Traffic Management Center

The system developed by IDC-Multisonics control 250 signals in the City of Santa Ana

- Communication Infrastructure is based on fiber optic and twisted pair cable.
- Signal control is based on a centralized architecture using the VMS 330 software, with NEMA controllers.
- Traffic data and information are collected through inductive loops.
- Traffic information distribution is done through DMS, HAR, and information kiosks.

#### Los Angeles County Regional TOC

Currently the system is under design. Ultimately, anticipate covering all of Los Angeles County. However, initially our system will cover the County's East San Gabriel Valley area. The ultimate system will have the following technologies and functionality:



- Communication Infrastructure is based on fiber optic, twisted pair cable, coaxial cable, and spread spectrum radio.
- Signal control is based on a centralized and distributed architecture to be determined and must work with both NEMA and model 170 controllers.
- Traffic data and information are collected through inductive loops and microwave detectors.

## Advanced Public Transportation Systems

### Transit Probe

Transit Probe operates over 500 buses. The system under design will incorporate an AVL, Passenger Information system and operators software.

### Los Angeles County Metropolitan Transit Authority

The Authority operates over 2085 buses. The system under design is a comprehensive APTS system that will include: passenger information system, electronic fare cards, sign post AVL system with silent alarm, engine component probes, two way data communication, Computer Aided Dispatching (CAD), and traffic signal preemption.

### Santa Monica Municipal Bus Line

The system operates 135 buses. The Santa Monica Municipal Bus Lines is employing an alternative form of fleet location. Their system, in regular operation since October 1992, uses Teletrac's network of transmitting and receiving antennas. The agency owns a PC-based workstation equipped with a modem, an Etak Map with a detailed database of the streets and addresses in the Los Angeles area, and communications and control software. The workstation communicates with the Teletrac control center through standard telephone lines, and the agency pays for the time its workstation is connected to the central computer. Thus, the agency does not request location information in real time, since it uses the information for planning and problem investigation only, and the cost of full-time connection would be prohibitive.

### Electronic Toll Collection System: Vincent Thomas Bridge

A two miles section of SR-47 From San Pedro to Los Angeles Harbor will be controlled by a tag based MFS and Texas Instrument ETC system. The system is expected to be operational by August 1997 - February 1998.

## LOUISVILLE

### Centralized Traffic Signal Control System: City Wide Traffic Signal System (C.W.S.S.)

The system being developed by Fredric R. Harris controls 580 signals in the Louisville City limits. The C.W.S.S. project status (as of March 1996): 1) Design 85% complete 2) Construction 15% complete

- Communication Infrastructure is based on fiber optic and coaxial cable.
- Signal control is based on a centralized and distributed architecture with model 170 controllers.
- Traffic data and information are collected through inductive loops.

Advanced Public Transportation System: Transit Authority of River City (TARC)

TARC operates over 250 buses. TARC's APTS system includes: Automatic Passenger Counters (APC), sign post AVL system with silent alarm, engine component probes, and Computer Aided Dispatching (CAD).

## MIAMI, FORT LAUDERDALE

### Freeway Management Centers

Golden Glades Interchange Control Center

The current center is established to control the integrated ATIS & ATMS for the region around the Golden Glades Interchange (GGI). The ATIS & ATMS system is still under construction. After completion of construction, it will provide assistance to all the incoming traffic, on freeway and arteries within approximately 4 mile radius of the GGI. The highways covered include I-95, SR 286, Florida's Turnpike, and SR 441, including all the freeways or freeway connecting ramps, entrance ramps, and exit ramps. The control center is expected to expand in two to three years to provide assistance to an additional 16 miles of I-95. This expanded control center will also provide additional user services for other modes of travel. After about six years, this center will merge with the SEFI Intelligent corridor systems and other southern Florida centers.

- Communication Infrastructure is based on fiber optic, coaxial cable, spread spectrum radio, and telephone lines.
- System capabilities will include: real time data collection, electronic incident detection and verification, lane use control (HOV only), and ramp metering.
- Traffic information collection is done using inductive loops, CCTV cameras, video imaging detectors, service patrol, cellular phone, and CB radio.
- Traffic information distribution is done using DMS, HAR, information kiosks, telephone information system, and commercial radio stations.

I-595 Changeable Message Sign System (CMSS)

The I-595 Changeable Message Sign System (CMSS) is being installed in phases; the information provided is for Phase I and Phase II. A management center is planned for the I-595 CMSS, and it is anticipated that the Florida DOT will operate the facility. The CMSS will control over 20 miles of freeway on I-595.

- Communication Infrastructure is based on fiber optic and twisted pair cable.
- System capabilities will include: real time data collection and electronic incident detection and verification.
- Traffic information collection is done using CCTV cameras and microwave detectors.
- Traffic information distribution is done using DMS.

#### Pompano Traffic Operations Center

The Pompano Traffic Operations Center will provide: Area surveillance of all mainline toll plazas Toll lane surveillance of select SunPass electronic toll collection system lanes General purpose lane surveillance of high-volume metropolitan areas of the Turnpike.

- Communication Infrastructure is based on fiber optic, microwave radio, satellite link, and twisted pair cable.
- System capabilities will include: real time data collection, electronic incident detection and verification, weigh-in-motion stations, toll violation enforcement cameras and permanent traffic counting stations.
- Traffic information collection is done using inductive loops, CCTV cameras, video imaging detectors, call boxes, cellular phones, service patrols, and vehicle probes.
- Traffic information distribution is done using DMS, HAR, information kiosks, commercial radio stations, and personal computers and Internet.

#### Incident Management Program: Freeway Management Committee

The Committee develops policies on how to manage over 105 thousand incidents in the Dade and Monroe Counties on an annual basis. It utilizes many of the same resources of the freeway management centers in the area.

### Centralized Traffic Signal Control Systems

#### Broward County Traffic Control Center

All traffic signals within the borders of Broward County are controlled by this system and Center. These include all signals on the State system as well as signals within the incorporated limits of cities within the County (by virtue of Traffic Engineering Agreements), and County signals. This comprises a total of approximately 1,250 devices being maintained.

- Communication Infrastructure is based on twisted pair cable.

- Signal control is based on a centralized distributed architecture using a UTCS software with NEMA controllers.
- Traffic data and information are collected through inductive loops.

#### Dade County Traffic Control Center

This center controls over 2100 signals in all of Dade County (1800+ sq. miles) Including 400+ sq. miles of urbanized area.

- Communication Infrastructure is based on fiber optic and twisted pair cable.
- Signal control is based on a centralized distributed architecture using a UTCS software with NEMA, pre-NEMA and model 170 controllers.
- Traffic data and information are collected through inductive loops.

### Advanced Public Transportation Systems

#### Metro-Dade Transit Agency

The Authority operates over 630 buses. The system under design is a comprehensive APTS system that will include: passenger information system, kiosks, automated trip planning, multiprovider reservation and integrated billing, GPS-based AVL system with GPS-based next stop messages, silent alarm, engine component probes, two way data communication, and Computer Aided Dispatching (CAD) tied together through a comprehensive operators software.

#### Broward County Transit

A contract was issued to design an APTS system to operate over 200 buses. The system capabilities will include: Automatic Vehicle Location - GPS, Computer Aided Dispatch, and Silent Alarm. Future possibilities include the following: Automatic Passenger Counters and Passenger Information Telephone Number.

### Electronic Toll Collection Systems

#### Rickenbacker Causeway

Rickenbacker Causeway is a three mile toll facility that utilizes a tag based Amtech system that communicates with the overhead antennae.

#### Venetian Causeway

Venetian Causeway is a two mile toll facility that utilizes a tag based Amtech system that communicates with the overhead antennae.

### Broad Causeway

The Broad Causeway Toll Collection System uses a bar code sticker placed on the vehicle to communicate with the roadside readers and debit the users account. Currently, about 25% of the traffic uses the ETC system.

### Florida Turnpike

The Florida DOT, Turnpike District plans to implement the "SunPass" system on the entire Florida Turnpike. Alligator Alley (I-75) and other toll routes in Miami, Tampa/St. Petersburg, and Orlando under the jurisdiction of the Florida DOT Turnpike District are also expected to be equipped with the SunPass System. This will be an RF AVI/ETTM system with "read-write" interactive capabilities and controlled by a central computer. The transponder will carry all account information and could be capable of receiving information on traffic conditions. The antennae will either be overhead or lane side. This type of system has the potential for use in tracking vehicle movements to determine travel speed and congestion conditions on area highways. The first phase of implementation is expected in southeast Florida around December, 1997. The second priority is in Orlando approximately one year later. Eventually the entire Florida Turnpike and the other toll roads in the coverage area will be operating the SunPass System, making it one of the world's largest AVI/ETTM systems.

## MILWAUKEE, RACINE

### Freeway Management Centers: Monitor Traffic Operations Center

The system cover a large area of interstate freeway and US and State routes in the Milwaukee, Racine area.

- Communication Infrastructure is based on spread spectrum radio, microwave radio, tele phone lines, and twisted pair cable.
- System capabilities will include: real time data collection, electronic incident detection, integrated transit and traffic operations, area-wide ramp meter control, mainline metering and control.
- Traffic information collection is done using inductive loops, CCTV cameras, video imaging detectors, and microwave detectors.
- Traffic information distribution is done using DMS, HAR, commercial radio stations, telephone information numbers, and personal computers via modem.

It is anticipated that at least two more additional stages (additional routes) to the MONITOR system be implemented. Additionally, a fiber optic communication network may be implemented at some point in the future. A permanent highway advisory radio system will also be implemented, anticipated to be in MONITOR Stage 4. Ultimately, the MONITOR system will operate from a state owned Traffic

Management Center (TMC), with incident management capabilities originating from this building. Other possible features to the MONITOR system would include integration of signal systems of various corridors throughout the Milwaukee area and an intertie to the Gary-Chicago-Milwaukee ITS priority corridor.

Incident Management Program: Milwaukee

Plans are in place to develop a cellular \*911 system with the Milwaukee County Sheriff's Department. Wisconsin DOT is in the initial stages of developing plans for an IMP as part of MONITOR.

Advanced Public Transportation System: Milwaukee County Transit System

The system operates over 540 buses. Although, portions of the system are in the design stage, the ultimate system is a comprehensive APTS system that includes: a GPS-based AVL system, Automatic Passenger Counters (APC), silent alarm, two way data communication, and a comprehensive operators software.

## MINNEAPOLIS, ST. PAUL

Freeway Management Centers: MN/DOT Traffic Management Center

This Center operates over 160 miles of freeway on I-94, I-394, I-494, I-694, I-35W, I-35E, US 212, US 169, SR 5, SR 36, SR 62, SR 77, and SR 100.

- Communication Infrastructure is based on fiber optic, microwave radio, coaxial and twisted pair cable.
- System capabilities will include: real time data collection, electronic incident detection and verification, lane use control, ramp metering, and mainline metering.
- Traffic information collection is done using inductive loops, CCTV cameras, video imaging detectors, call boxes, cellular phones, Autoscope, two-way radio, surveillance aircraft, and service patrols.
- Traffic information distribution is done using DMS, HAR, commercial radio stations, telephone information numbers, and cable television.

The incident management program under the TMC responds to over 50,000 incidents annually with an average respond time of under seven minutes and an average clearance time of 27 minutes.

## Centralized Traffic Signal Control Systems

### City of St. Paul

The system developed by Computran, controls 340 signals in the City of St. Paul. Portions of the system are under design.

- Communication Infrastructure is based on fiber optic and twisted pair cable.
- Signal control is based on a centralized architecture using a UTCS software, with model 170 controllers.
- Traffic data and information are collected through inductive loops and CCTV cameras.
- Traffic information distribution is done through DMS.

### Minneapolis Traffic Engineering

Of the 790 signalized intersections, 735 are operated under a Fortran Traffic Systems centralized control.

- Communication Infrastructure is based on twisted pair cable.
- Signal control is based on a centralized and distributed architecture using T2000C software, with elector mechanical, non-NEMA solid state and NEMA controllers.
- Traffic data and information are collected through inductive loops and CCTV cameras with VIDS and radar detectors.

### Advanced Public Transportation System: Metropolitan Council Transit Operations (MCTO)

The system operates over 900 buses. The system is a comprehensive APTS system that includes: a GPS-based AVL system, Automatic Passenger Counters (APC), Computer Aided Dispatching (CAD), two way data communication, passenger information system, real-time rideshare matching and a comprehensive operators software.

## NASHVILLE

### Centralized Traffic Signal Control System: Metro Nashville Traffic Control Center

The original system, developed by Frederick R. Harris, was installed in 1987. The system installed in 1996 (MIST) is upgrading and replacing the system installed in 1994 (KVE Systems). The 188 NEMA controllers under construction and the 375 in design include controllers that were in the

original system, and are being replaced or upgraded. The current 486 PC central computer is being replaced by a Pentium computer. The 65 inductive loops are installed, but are not operational at this time. They include only system sampling detectors, and do not include intersection approach detectors.

- Communication Infrastructure is based on fiber optic and twisted pair cable.
- Signal control is based on a centralized and distributed architecture using a UTCS, MIST and the Transyt's Smartways software, with NEMA and electro mechanical controllers.
- Traffic data and information are collected through inductive loops.

## NEW HAVEN, MERIDEN

Freeway Management Centers: Bridgeport Operations Center

The Bridgeport Operations Center has electronic surveillance along 56 miles of I-95 from the New York state line to New Haven in southwest Connecticut. Bridgeport Operations Center operates 44 Changeable Message Signs, 36 are along I-95 and 8 are along arterial streets. The 48 personnel, \$3,000,000 budget, and \$30,000,000 capital construction cost includes the Newington Operations Center and the Bridgeport Operations Center.

- Communication Infrastructure is based on fiber optic.
- System capabilities will include: real time data collection.
- Traffic information collection is done using CCTV cameras, call boxes, radar detectors, and service patrols.
- Traffic information distribution is done using DMS, commercial radio stations, and telephone information numbers.

The incident management program cover I-95 from Greenwich to Branford

## Centralized Traffic Signal Control Systems

Bridgeport Operations Center

The Bridgeport Operations Center monitors 200 signalized intersections in southwest Connecticut.

- Communication Infrastructure is based on leased and dial up telephone lines and twisted pair cable.
- Signal control is based on a distributed architecture using a closed loop software, with NEMA controllers.
- Traffic data and information are collected through inductive loops.



- Traffic information distribution is done through DMS.

#### New Haven Master Traffic Control Center

Phase 1 covered downtown CBD and Yale New Haven Hospital area. Phase 2 covers the grid to the west of the CBD and two major arterials to the north. Phase 2.5 covers US Route 1 west of the Quinnipiac River and few miscellaneous signals on the fringes of the CBD. The proposed phase 3 would cover the Fairhave section (east side) and the Hill section (south side access roads) along I-95 and arterials in the north and west. The City of New Haven operates approximately 300 signalized intersections, 78 are currently under centralized control, and another 52 are currently being added to the centralized control system. There are currently 51 system inductive loop detectors, and 23 more being installed.

- Communication Infrastructure is based on twisted pair cable.
- Signal control is based on a centralized and distributed architecture using the JHK Series 2000, with NEMA controllers.
- Traffic data and information are collected through inductive loops.

#### Advanced Public Transportation System: Connecticut Department of Transportation - New Haven

Connecticut Department of Transportation operates a total of 370 buses. There are 220 buses in Hartford, 113 in New Haven, and 37 in Stamford. The current APTS technology deployed is electronic and automated trip payment.

## NEW ORLEANS

#### Centralized Traffic Signal Control System: City of New Orleans

The System with operates the Orleans Parish operates 38 signals under the central control. There are plans to expand the system and the list below reflect the existing and the planned technologies and capabilities.

- Communication Infrastructure is based on fiber optic and twisted pair cable.
- Signal control is based on a distributed architecture using the Smartways, with electro mechanical, NEMA, and model 179 controllers.
- Traffic data and information are collected through inductive loops, CCTV cameras, and radar detectors.

#### Electronic Toll Collection System

##### Lake Pontchartrain Causeway

The Greater New Orleans Expressway Commission has issued over 19,000 tags for use on the

Lake Pontchartrain Causeway. Other ITS technologies installed at the Lake Pontchartrain Causeway include Weigh-In-Motion Stations, and 12 Variable Message Signs. The system is an Amtech tag-based system with roadside antennae.

#### Crescent City Connection

The system installed on a one mile section of US 90B across the Mississippi River is an Amtech tag-based system with roadside antennae. There are over 61,000 tags in use.

## NEW YORK, NORTHERN NEW JERSEY, LONG ISLAND

### Freeway Management Centers

#### Northern New Jersey Traffic Operations Center

This system puts the northern 44 miles of the New Jersey Turnpike under operator surveillance.

- Communication Infrastructure is based on microwave radio, coaxial and twisted pair cable.
- System capabilities will include: real time data collection, electronic incident detection, and mainline metering.
- Traffic information collection is done using inductive loops, CCTV cameras, CCTV with VIDS, cellular phones, CB radio, and service patrols.
- Traffic information distribution is done using DMS, HAR, commercial radio stations' information kiosks, and telephone information numbers.

The center operates an incident management programs over its cover area.

#### INFORM

This advanced traffic information system covers Long Islands's 35-miles central corridor, consisting of the Islands's major east/west highways and their busiest north/south connecting routes.

- Communication Infrastructure is based on fiber optics, coaxial and twisted pair cable.
- System capabilities will include: real time data collection, electronic incident detection and verification, and ramp metering.
- Traffic information collection is done using inductive loops, CCTV cameras, CCTV with VIDS, CB radio, and service patrols.
- Traffic information distribution is done using DMS, HAR, commercial radio stations, cable TV, and telephone information numbers, and personal computers via modem.

### Metropolitan Area Guidance Information Center (MAGIC)

The system covers over 92 miles of roadway on I-80 from George Washington Bridge to mile post 40.8: 28.5 miles SR 17 from mile post 6.7 to mile post 12.3: 5.6 miles SR 4 from mile post 2.2 to mile post 10.9: 8.7 miles US 46 from mile post 47.5 to mile post 72.0: 24.5 miles I-287 from mile post 37.1 to mile post 44.5: 7.4 miles I-280 from mile post 0 to mile post 2.5: 2.5 miles I-95 from mile post 117.1 to mile post 122.5: 5.4 miles US 1, US 9, US 46 from mile post 62.8 to mile post 64.8: 2.0 miles SR 23 from mile post 4.7 to US 202: 7.7 miles.

- Communication Infrastructure is based on fiber optics, microwave radio, digital telephone lines, coaxial and twisted pair cable.
- System capabilities will include: real time data collection, electronic incident detection and verification, and ramp metering.
- Traffic information collection is done using inductive loops, CCTV cameras, CCTV with VIDS, call boxes, two-way radio, CB radio, and service patrols.
- Traffic information distribution is done using DMS, HAR, information kiosks, TRANSCOM pager, and Regional Traffic Information Center.

### Incident Management Programs

#### TRANSCOM

TRANSCOM covers 28 counties in CT, NY, and NJ. This includes all interstate, U.S. and state roadways, as well as major secondary roadways. TRANSCOM has very limited direct surveillance capabilities and depends primarily on agencies to report incidents. TRANSCOM serves its agencies as an information and communication clearinghouse, and does not have on-site response responsibility.

#### Highway Emergency Local Patrol (HELP)

The program provides free emergency road service to motorists traveling on sections of various expressways in the coverage area and has over 170 miles of coverage. It uses 22 HELP trucks and made 32,000 stops in its first year of operation.

#### New Jersey Turnpike Incident Management

This program responded over 95,100 incident in 1995. The breakdown of the number of incidents by type is 90,000 disabled vehicles 5,000 accidents 100 HAZMAT spills.

### Centralized Traffic Signal Control System

NYC DOT Traffic Management Center - 5 Boroughs in New York City, the Bronx, Brooklyn, Manhattan, Queens, and Staten Island are under the control of this center. The Center operates over 6000 signalized intersections using a system developed by JHK and Associates.

- Communication Infrastructure is based on fiber optic and coaxial cable.
- Signal control is based on a centralized architecture using a UTCS, VTCS system with electro mechanical and model 170 controllers.
- Traffic data and information are collected through inductive loops, and CCTV cameras.
- Traffic information distribution is done using DMS.

#### Westchester County

The system operates 15 signals along Westchester Avenue in the City of White Plains.

- Communication Infrastructure is based on twisted pair cable.
- Signal control is based on a centralized architecture using a UTCS system developed by TRA-Flow Corp., with NEMA controllers.
- Traffic data and information are collected through inductive loops.

#### White Plains Traffic Control Center

City of White Plains operates 96 traffic signals and is in the process of upgrading the system functionalities and capabilities.

- Communication Infrastructure is based on fiber optic and twisted pair cable.
- Signal control is based on a centralized and distributed architecture using JHK Series 2000 with 1.5 generation control software with non-NEMA solid state, NEMA, and model 170 controllers.
- Traffic data and information are collected through inductive loops, microwave detectors, and CCTV cameras.

#### Nassau County Central Traffic Signal Computer

Nassau County is located on Long Island, approximately 25 miles east of New York City. In Nassau County there are 1,948 traffic signals. 1,471 of these signals are owned and maintained by Nassau County. Currently, 560 of these signals are under computer control with current plans to bring another 101 on line within the next year. Nassau County is made up of many east/west arterials with high westbound volumes in AM peaks and high eastbound volumes in PM peaks.

- Communication Infrastructure is based on fiber optic and twisted pair cable.
- Signal control is based on a centralized architecture using JHK using Computrans UTCS software with NEMA controllers.
- Traffic data and information are collected through inductive loops.

#### Traffic Operations Center - North, Newark NJ

New Jersey DOT is installing closed loop systems along various arterials in Northern New Jersey. Arterials with traffic signal system presently installed or under construction are: RT 24/202 (Morris County) RT 9 (Middlesex and Monmouth Counties) RT 1, RT 9 (Essex, Union, and Middlesex Counties) New Jersey DOT is also presently completing installation of an Intelligent Transportation System Traffic Control System on RT 18 in New Brunswick and East Brunswick. This system uses OPAC to run traffic adaptive control on RT 18. All Systems will be operated from TOC-North. The Traffic Operations Center-North will utilize a Video Imaging Detector, Changable Message Signs and Highway Advisory Radio in conjunction with the MAGIC freeway management system.

- Communication Infrastructure is based on fiber optic.
- Signal control is based on a distributed architecture using OPAC and MATS software with NEMA and model 170 controllers.
- Traffic data and information are collected through inductive loops, CCTV cameras, radar detectors, and video imaging detectors.
- Traffic information distribution is done using DMS and HAR.

#### Advanced Public Transportation Systems

##### Connecticut Department of Transportation - Stamford

Connecticut Department of Transportation operates a total of 370 buses. There are 220 buses in Hartford, 113 in New Haven, and 37 in Stamford. Thirty seven of the buses have been equiped with electornic and automated trip payment.

##### New Jersey Transit

This agency operates over 800 buses has deployed a comprehensive APTS that includes: passenger information systems, telephone information number, sign post-based AVL, silent alarm system, two-way communications, Computer Aided Dispatching (CAD), and GPS based next stop messages.

##### MTA Long Island Bus

The system under design will help operation of the 318 buses system with implementation of a GPS-based AVL, Computer Aided Dispatching (CAD), silent alarm, and passenger informaiton system.

##### New York City Transit

New York City Transit (NYCT) will soon be installing a combination GPS and dead-reckoning AVL system on four of its routes operating out of its 126th Street garage in Manhattan; 170 buses and 30 non-revenue vehicles will be AVL-equipped. Although the system will be used for restoring service and ensuring on-time performance, AVL is designed primarily for inputs to the passenger information

system - kiosks at transfer locations and tourist attractions and monitors and signs at selected bus stops shelters.

## Electronic Toll Collection Systems

### New York State Thruway

The tag based (Mark IV) ETC system uses on overhead antennae and operate on the NYS Thruway between New York City and Albany.

### Triborough Bridge

The tag based (Mark IV) ETC system uses on overhead antennae and operate on I-278 from Bronx to Queens.

### Bronx - Whitestone Bridge

The tag based (Mark IV) ETC system uses on overhead antennae and operate on I-678 from Bronx to Queens.

### Throngs Neck Bridge

The tag based (Mark IV) ETC system uses on overhead antennae and operate on I-295 from Bronx to Queens.

### Verrazano - Narrows Bridge

The tag based (Mark IV) ETC system uses on overhead antennae and operate on I-278 from Staten Island to Brooklyn.

### Queens Midtown Tunnel

The tag based (Mark IV) ETC system uses on overhead antennae and operate on I-495 from Manhattan to Queens.

### Brooklyn Battery Tunnel

The tag based (Mark IV) ETC system uses on overhead antennae and operate on I-478 from Manhattan to Brooklyn.

### Bayonne Bridge

The tag based (Mark IV) ETC system uses on overhead antennae and operate on a 2 miles section from NJ SR 501 to Willowbrook Expressway. (In design stage will be operational by end of 1998.)

### Outerbridge Crossing

The tag based (Mark IV) ETC system uses on overhead antennae and operate on a 2 miles section of SR 440 from Perth Amboy, NJ to Staten Island, NY. (In design stage will be operational by end of 1998.)

### Lincoln Tunnel

The tag based (Mark IV) ETC system uses on overhead antennae and operate on a 2 miles section of SR-495 from Weehawken, NJ to Manhattan, NY. (In design stage will be operational by end of 1998.)

### Marine Parkway Bridge

The tag based (Mark IV) ETC system uses on overhead antennae and operate on Flatbush Ave. from Kings County to Queens County.

### Cross Bay Veteran's Memorial Bridge

The tag based (Mark IV) ETC system uses on overhead antennae and operate on Cross Bay Blvd. across Jamaica Bay.

### Henry Hudson Bridge

The tag based (Mark IV) ETC system uses on overhead antennae and operate the bridge from Manhattan to Bronx.

### New England Thruway

The tag based (Mark IV) ETC system uses on overhead antennae and operate on 15 miles of I-95 from Pelham Parkway to Connecticut.

## NORFOLK, VIRGINIA BEACH, NEWPORT NEWS

### Freeway Management Centers

#### Traffic Management System of Hampton Roads

This system cover 19 miles of freeway on I-64 between I-564 & I-264/VA-44.

- Communication Infrastructure is under design and the information is not available at this time.
- System capabilities will include: real time data collection.
- Traffic information collection is done using inductive loops, CCTV cameras, two-way radio, and service patrols.

- Traffic information distribution is done using DMS, HAR, commercial radio stations, telephone information numbers, and personal computers via modem.

#### Hampton Roads Bridge-Tunnel

Part of the Tidewater Tunnel and Bridge Management Systems. VA DOT is in the process of integrating the 3 tunnel traffic management systems: Elizabeth River Downtown and Midtown Tunnels, Hampton Roads Bridge-Tunnel, and Monitor-Merrimac Memorial Bridge-Tunnel. Each system will be linked with a central computer. The central system will fuse this information and provide a graphic display of traffic conditions in the Hampton Roads region. At this time there are plans to provide up to 36 access ports that will allow local TV stations and major activities centers the capability to provide traveler information services based on VA DOT's monitoring system.

- Communication Infrastructure is under design and the information is not available at this time.
- System capabilities will include: real time data collection.
- Traffic information collection is done using inductive loops, CCTV cameras, vehicle probes, and service patrols.
- Traffic information distribution is done using DMS, HAR, and telephone information numbers.

#### Monitor - Merrimac Memorial Bridge-Tunnel

The system covers 7 miles of freeway on I-64 Monitor - Merrimac Memorial Bridge-Tunnel.

- Communication Infrastructure is under design and the information is not available at this time.
- System capabilities will include: real time data collection.
- Traffic information collection is done using inductive loops, CCTV cameras, vehicle probes, and service patrols.
- Traffic information distribution is done using DMS, HAR, and telephone information numbers.

#### Elizabeth River Downtown and Midtown Tunnels

The system covers 3 miles of freeway on I-264 Downtown Tunnel.

- Communication Infrastructure is under design and the information is not available at this time.
- System capabilities will include: real time data collection.
- Traffic information collection is done using inductive loops, CCTV cameras, and vehicle probes.



- Traffic information distribution is done using DMS, HAR, and telephone information numbers.

#### Centralized Traffic Signal Control System: Norfolk Traffic Signal System

City of Norfolk is responsible for maintaining 100 traffic signals using a Sonex closed loop system.

- Communication Infrastructure is based on fiber optic and twisted pair cable.
- Signal control is based on a centralized and distributed architecture using a closed loop software with NEMA and model 170 controllers.
- Traffic data and information are collected through inductive loops, CCTV cameras, CCTV cameras with VIDS, and radar detectors.
- Traffic information distribution is done using DMS and HAR.

#### Advanced Public Transportation System: Tidewater Regional Transit (TRT)

Tidewater Regional Transit (TRT) has been operating a signpost and odometer system procured from F & M Global since 1991 on all of its vehicles. The computer at dispatch polls the vehicles every 40 seconds. There is no grand map display, since the system was developed before the recent advances in computer technology and software. TRT uses the system for real-time corrections to service, and to produce "tighter" schedules. According to TRT, the system is functioning very well in both of these roles. In addition, they note a reduction in passenger complaints since the system was implemented and a better ability to respond to complaints in general.

## OKLAHOMA CITY

#### Centralized Traffic Signal Control System: Oklahoma City Traffic Control Center

The system controls 132 signals in the CBD of the City.

- Communication Infrastructure is based on fiber optic and twisted pair cable.
- Signal control is based on a centralized and distributed architecture using the Multisonics software with NEMA controllers.
- Traffic data and information are collected through inductive loops and radar detectors.
- Traffic information distribution is done using DMS and HAR.

## Electronic Toll Collection Systems

#### Turner Turnpike

The tag based (Amtech) ETC system uses overhead antennae on the Turnpike between Oklahoma City and Tulsa.

### H.E. Bailey Turnpike

The tag based (Amtech) ETC system uses overhead antennae on the Turnpike From US 62 south of Oklahoma City to US 62 north of Lawton and SR 26 South of Lawton to US 70 west of Randlett.

### Kilpatrick Turnpike

The tag based (Amtech) ETC system uses overhead antennae on the Turnpike From I-35 to Hefner Parkway.

## OMAHA

Centralized Traffic Signal Control System: City of Omaha

City is responsible for maintaining over 500 signal.

- Communication Infrastructure is based on twisted pair cable.
- Signal control is based on a distributed architecture using the WAPITI/D.M. software with model 170 controllers.
- Traffic data and information are collected through inductive loops and radar detectors.

## ORLANDO

Freeway Management Centers I-4 Surveillance and Motorist Information System (I-4 SMIS)

The center is responsible for the operation of I-4 from Lake Mary south to the Southern

Connector Extension . This center is electronically linked to the Orlando Traffic Management Center (TMC) in downtown Orlando which coordinates Orlando's UTCS. The linkage provides for information sharing and coordination between city streets and I-4.

- Communication Infrastructure is based on fiber optics, coaxial and twisted pair cable.
- System capabilities will include: real time data collection, electronic incident detection and verification, lane use control, ramp metering and reversible lane ramp metering.
- Traffic information collection is done using inductive loops, CCTV cameras, call boxes, cellular phones, vehicle probes, surveillance aircraft, and service patrols.
- Traffic information distribution is done using DMS and commercial radio stations.

#### Incident Management Program: Tri-County Freeway Management Team

This team responds to over 58,000 incidents in the I-4 Corridor, and in the future will cover SR 408/ East West Expressway.

### Centralized Traffic Signal Control Systems

#### Metro Orlando Computerized Signal System (MOCSS)

Coverage is primarily within Orlando City limits, plus selected state roads outside of city limits. In all over 400 signals are controlled by MOVSS.

- Communication Infrastructure is based on fiber optic and twisted pair cable.
- Signal control is based on a centralized architecture using a UTCS software with NEMA controllers.
- Traffic data and information are collected through inductive loops and radar detectors.

#### Seminole County Action Center (SEMTAC)

The system covers 89 signals along major arterials in Seminole County.

- Communication Infrastructure is based on fiber optic, spread spectrum radio, UHF radio, and twisted pair cable.
- Signal control is based on a distributed architecture using a Transyt software with NEMA controllers.
- Traffic data and information are collected through inductive loops and CCTV cameras.

#### Advanced Public Transportation System: LYNX

LYNX is currently developing plans for a pilot test of a GPS base AVL system, that was to be conducted during the fall of 1996. Currently, there are video monitors on several buses which provide information about the area and bus routes. A Voice Enunciation System is being installed, currently it will be manually controlled but it may be automated when AVL is installed on the buses.

### Electronic Toll Collection Systems

#### Florida Turnpike

Over 80 miles of ETC in Orlando and Seminole County. The Florida DOT, Turnpike District plans to implement the "SunPass" system on the entire Florida Turnpike. Alligator Alley (I-75) and other toll routes in Miami, Tampa/St. Petersburg, and Orlando under the jurisdiction of the Florida DOT Turnpike District are also expected to be equipped with the SunPass System. This will be an RF AVI/ETTM system with "read-write" interactive capabilities and controlled by a central computer. The

transponder will carry all account information and could be capable of receiving information on traffic conditions. The antennae will either be overhead or lane side. This type of system has the potential for use in tracking vehicle movements to determine travel speed and congestion conditions on area highways. The first phase of implementation is expected in southeast Florida around December, 1997. The second priority is in Orlando approximately one year later. Eventually the entire Florida Turnpike and the other toll roads in the coverage area will be operating the SunPass System, making it one of the world's largest AVI/ETTM systems.

East-West Expressway, Greenway Expressway, and Beeline Expressway

The EPass system is a tag based system (Mark IV) with in-pavement antennae. It has been implemented on the East-West Expressway, Greenway Expressway, and the Beeline Expressway. Currently, there are 50,000 transponders in use.

## PHILADELPHIA, WILMINGTON, TRENTON

### Freeway Management Centers

#### I-476 Ramp Metering Project

There are 16 centralized computer controlled ramp meters under construction on I-476. These meters will operate under fixed time, local adaptive, and area-wide control depending on the traffic volumes. The meters will be activated by time of day; however, local traffic adaptive control may occur 24 hours per day in response to incidents. A future expansion includes 17 meters on I-95. Construction is scheduled for 1997-2005. This project also includes an Advanced Vehicle Detector (AVD) test station that comprises overhead-mounted and side-fired AVDs and inductive loop detectors. AVDs incorporates video processing and microwave radar technologies will be used at this test station.

- Communication Infrastructure is based on fiber optics, spread spectrum radio, and leased telephone lines.
- System capabilities will include: real time data collection, electronic incident detection, and ramp metering.
- Traffic information collection is done using inductive loops, CCTV cameras, radar detectors, and side-fired radar.

#### Incident Management Program: Traffic and Incident Management System (TIMS)

This Incident Management Program operates on the Pennsylvania Turnpike, throughout the state, and dispatches towing, ambulance, and medical helicopter service. Program has been deployed on: 12 miles of I-95 from SR-420 to Bridge Street, and is under Construction on: 22 miles of I-476 from I-95 to I-276 Under Design: 1.5 miles of I-676 between I-95 and I-76.

## Electronic Toll Collection Systems

Franklin Bridge, Walt Whitman Bridge, Betsy Ross Bridge, Commodore John Barry Bridge

Electronic Toll Collection is available for passenger cars only, weighing less than 7,000 pounds. These systems use IC cards and bar codes with focused beam roadway antennae.

## PHOENIX

Freeway Management Center: Phoenix Traffic Operations Center

Phase 1 (Completed Fall 95) covered I-10 for 19.6 miles and I-17 for 9.4 miles. Phase 2 (In progress 1/1/96) covers SR51 for 5.5 miles, SR143 for 4 miles, and Loop 202 for 3 miles.

- Communication Infrastructure is based on fiber optics, telephone lines, coaxial and twisted pair cable.
- System capabilities will include: real time data collection, electronic incident detection and verification, lane use control, ramp metering, traffic interchange control, incident management team, and emergency notification system.
- Traffic information collection is done using inductive loops, CCTV cameras, call boxes, passive acoustic detectors and statewide radio.
- Traffic information distribution is done using DMS, information kiosks, telephone information numbers, and personal computers and Internet.

The incident management program operated by the TOC covers all of Maricopa County and parts of Pinal County.

## Centralized Traffic Signal Control Systems

City of Phoenix

Central Phoenix is covered by the existing system, distributed control for entire city is currently under design and will control over 480 signalized intersections.

- Communication infrastructure is based on fiber optic, leased telephone lines, and twisted pair cable.
- Signal control is based on a centralized and distributed architecture using a UTCS software with NEMA TS-1 and TS-2 controllers.
- Traffic data and information are collected through inductive loops and CCTV cameras.

#### City of Scottsdale

The City is responsible for the operation and maintenance of over 200 traffic signals within the City limits.

- Communication infrastructure is based on and twisted pair cable.
- Signal control is based on a distributed architecture using the JHK Series 2000 software with model 170 controllers.
- Traffic data and information are collected through inductive loops.

#### City of Mesa

The City is responsible for the operation and maintenance of over 255 traffic signals within the City limits.

- Communication infrastructure is based on micorwave radio, fiber optic, and twisted pair cable.
- Signal control is based on a distributed architecture using the Sonex ESCORT software with NEMA TS-1 and TS-2 controllers.
- Traffic data and information are collected through inductive loops, CCTV cameras, and Autoscope.

#### City of Tempe Traffic Operations

The City is responsible for the operation and maintenance of over 155 traffic signals within the City limits.

- Communication infrastructure is based on fiber optic and twisted pair cable.
- Signal control is based on a centralized and distributed architecture using UTCS, RHODES, and MTCS softwares with NEMA TS-2 controllers.
- Traffic data and information are collected through inductive loops and video imaging detectors.

#### Advanced Public Transportation System: Valley Metro

Valley Metro is a collaboration of the following transit operators and their contractors in the Phoenix metropolitan area: City of Phoenix - ATC Vancom - Mayflower Laidlaw - City of Mesa -

Dave Transportation System - City of Scottsdale

The system operates over 450 buses using GPS-based AVL, Computer Aided Dispatching (CAD), silent alarm system, automatic enunciation system. Electronic fare card and a comprehensive operators software.

## PITTSBURGH, BEAVER VALLEY

Centralized Traffic Signal Control System: City of Pittsburgh

The City is responsible for the operation and maintenance of over 93 traffic signals under this system.

- Communication infrastructure is based on fiber optic.
- Signal control is based on a distributed architecture using a UTCS softwares with model 170 controllers.
- Traffic data and information are collected through inductive loops..

Advanced Public Transportation System: Beaver County Transit Authority (Rochester, PA)

The Beaver County Transit Authority has been operating a Motorola Loran-C system on 13 of its 36 fixed-route fleet since 1991. The agency feels the system has been a valuable tool, and has noted that on-time performance has increased noticeably since the system's installation, and that passenger complaints have decreased. The Loran-C is scheduled to be replaced. Rochester is a National Pilot Site for a Mobility Manager system which will include an updated AVL system. A performance-based specification for a GPS system was to be completed by the end of 1995.

## PORTLAND, VANCOUVER

Freeway Management Center: Portland Traffic Management Operations Center

The Center operates I-5 (25 mi), I-205 (35 mi), I-84 (13 mi), I-405 (4 mi), US 26 (9 mi), SR 217 (7 mi), SR 99E (6 mi), and SR 224 (4 mi). The Incident Response Program in Portland, which was planned to be operational by July 1, 1996, will be coordinated with the Portland Traffic Management Operations Center.

- Communication Infrastructure is based on fiber optics, microwave radio, and coaxial cable.
- System capabilities will include: real time data collection, electronic incident detection and verification, lane use control, ramp metering, and mainline metering.
- Traffic information collection is done using inductive loops, CCTV cameras, cellular phones, vehicle probes, and service patrol.
- Traffic information distribution is done using DMS, HAR, commercial radio stations, and telephone information numbers.

The Incident Response Program (IRP) coordinates activities with the Portland Traffic Management Operations Center (TMOC). The IRP will utilize technologies deployed by the TMOC for incident detection and verification.

#### Centralized Traffic Signal Control System: Portland Traffic Operations Center

There are a total of 930 traffic signals within the Portland City limits, 400 of which communicate with the central computer.

- Communication infrastructure is based on fiber optic, coaxial, and twisted pair cables.
- Signal control is based on a distributed architecture using the JHK Series 2000 software with non-NEMA, NEMA, and model 170 controllers.
- Traffic data and information are collected through inductive loops.
- Traffic information distribution is done using DMS and HAR.

#### Advanced Public Transportation System: Tri-Met

The 770 buses (of which 140 are small lift buses for the elderly and handicapped) were to be equipped with AVL and two-way data communications by September 1, 1996. The automated demand responsive dispatching, which is currently deployed, refers to the 140 small lift buses only. The passenger information system consists of monitors for displaying traveler information and an automated trip planning system.

## PROVIDENCE, PAWTUCKET, FALL RIVER

#### Freeway Management Center: Traffic Operations Center

The Center operates I-95 from south of Route 10 north to Providence/Pawtucket line I-195 from I-95 east to Route 114 Route 10 from I-95 east to Dean Street. The construction of the Traffic Operations Center will be conducted in 2 phases. Phase I includes installation of 6 Portable Variable Message Signs, 2 Permanent Variable Message Signs, and 7 CCTV locations. Phase I was to be completed by late 1996 - early 1997. Phase II includes installation of 11 Permanent Dynamic Message Signs and 10 CCTV locations, and will be completed by late 1997.

- Communication Infrastructure is based on fiber optics, cellular to remote VMS's.
- System capabilities will include: real time data collection, electronic incident detection and verification.
- Traffic information collection is done using inductive loops, CCTV cameras, call boxes, cellular phones, vehicle probes, and service patrol.
- Traffic information distribution is done using DMS, HAR, and telephone information numbers.

#### Centralized Traffic Signal Control System: State of Rhode Island Arterial Project

Currently, the State of Rhode Island is designing closed loop traffic signal control systems for 10 arterials in the State. The Traffic Operations Center will operate the traffic signal systems in conjunc-



tion with the freeways. When an incident occurs on the freeway, motorists will be advised by Dynamic Message Signs of alternate routes on the arterial streets, and the signal timings on the arterial streets will be modified to accommodate the additional traffic.

- Communication infrastructure is based on spread spectrum radio and twisted pair cables.
- Signal control is based on a distributed architecture using NEMA controllers.
- Traffic data and information are collected through inductive loops.

## RALEIGH-DURHAM

Incident Management Program: Motor Assistance Patrol

The Patrol responds to over 12,000 incidents on I-40, I-440, and I-85 are patrolled. Other routes are serviced when an incident is reported.

Centralized Traffic Signal Control System: Raleigh Traffic Control Center

The Center maintains operation of over 400 traffic signals within the municipal corporate limits of Raleigh.

- Communication infrastructure is based on twisted pair cables.
- Signal control is based on a centralized using an enhanced UTCS software with NEMA controllers.
- Traffic data and information are collected through inductive loops and CCTV cameras.

Advanced Public Transportation System: Capital Area Transit

Recently the City of Raleigh released a Request for Proposals to upgrade their transit system. Technologies which may be considered for implementation are Automatic Vehicle Location (AVL) system, and two-way data communications. The existing system provided interactive cable access channel.

## RICHMOND, ST. PETERSBURG

Centralized Traffic Signal Control System: Richmond Signal System

The system developed by Fredric R. Harris and Eagle operates over 260 traffic signals from as far west as 25th Street, westward to I-195, north to I-95, and south to the James River.

- Communication infrastructure is based on coaxial cable.
- Signal control is based on a centralized architecture using the Eagle MONARC software with NEMA controllers.

- Traffic data and information are collected through inductive loops.

## ROCHESTER

Centralized Traffic Signal Control System: Rochester/Monroe County Traffic Control Center

There are 341 traffic signals within the City of Rochester, 30 traffic signals in two adjacent suburbs that are on the Sperry UTCS system, and 10 suburban signals on an Econolite closed loop system.

- Communication infrastructure is based on coaxial cable, microwave radio and twisted pair cable.
- Signal control is based on a centralized and distributed architecture using a UTCS and the Zone Monitor software with NEMA controllers.
- Traffic data and information are collected through inductive loops and microwave detectors.

Advanced Public Transportation System: Rochester Genesee Regional Transit Authority

The Authority operates over 215 buses with 10 buses equipped with a GPS based next stop message system. The system also has a passenger information system, interactive voice response system, automated telephone help services and Computer Aided Dispatching (CAD).

## SACRAMENTO

Freeway Management Centers: CHP/Caltrans Transportation Management Center

The Center operates over 41 miles of freeway on SR 99 (12 miles), I-80 (2 miles), I-80 Business (9 miles), and SR 50 (18 miles).

- Communication Infrastructure is based on leased telephone lines, dial up telephone lines and ISDN lines.
- System capabilities will include: real time data collection, electronic incident detection and verification, and ramp metering.
- Traffic information collection is done using inductive loops, CCTV cameras, call boxes, video imaging detectors, and service patrol.
- Traffic information distribution is done using DMS, HAR, and FAX service to media.

Incident Management Program: Incident Management Program

The Incident Management Program in Sacramento is divided into the following functions: a) Transportation Management Center: 1. Detection and Verification using Computer Aided Dispatch and Closed Circuit TV 2. Disseminate Information b) Traffic Management Team: Advance Warning c)

Freeway Service Patrol: Detection, response and clearance. This program handles over 9150 incidents annually.

Centralized Traffic Signal Control System: Traffic Operations Center

The Center controls over 250 traffic signals in the Central Area/Downtown bounded by Richards Blvd. on the north Broadway on the south 2nd St. on the west Alhambra St. (31st) on the east.

- Communication infrastructure is based on fiber optic and twisted pair cable.
- Signal control is based on a distributed architecture using the JHK Series 2000 software with NEMA and model 170 controllers.
- Traffic data and information are collected through inductive loops and CCTV cameras.

## SALT LAKE CITY

Centralized Traffic Signal Control System: Salt Lake City Transportation Division

The system developed by JHK & Associates and Computran controls over 220 signalized intersections in the City limits.

- Communication infrastructure is based on fiber optic and twisted pair cable.
- Signal control is based on a centralized and distributed architecture using a UTCS software with NEMA controllers.
- Traffic data and information are collected through inductive loops and CCTV cameras, and CCTV cameras with VIDS.
- Traffic information distribution is done using DMS and HAR.

## SAN ANTONIO

Freeway Management Center: TransGuide

Currently there are 26 miles of freeways under electronic surveillance, by August 1996 there was to be a total of 57 miles.

- Communication Infrastructure is based on fiber optics, coaxial, and twisted pair cable.
- System capabilities will include: real time data collection, electronic incident detection and verification, and lane use control.
- Traffic information collection is done using inductive loops, CCTV cameras, video imaging detectors, and sonic detectors.

- Traffic information distribution is done using DMS, HAR, and information kiosks, low power television, and personal computers and Internet.

There is no documented procedure for Incident Management. San Antonio Police Department will have full dispatch from TransGuide. Procedures for system/camera controls are being formulated. The Courtesy Patrol assists motorists and SAPD at incident scenes. Again, no formal document exists.

Centralized Traffic Signal Control System: Central Business District Control Center

The system controls over 600 signalized intersections in the City limits.

- Communication infrastructure is based on fiber optic, coaxial, and twisted pair cable.
- Signal control is based on a centralized and distributed architecture using the QUICNET software with model 170 controllers.
- Traffic data and information are collected through inductive loops.

Advanced Public Transportation System: VIA

VIA operates over 520 buses using a sign post AVL system with two-way communications, operators software, and kiosks.

## SAN DIEGO

Freeway Management Center: San Diego Transportation Management Center

The system is operational in some aspects and under construction to expand its capabilities. The Center covers the operations on I-5, I-8, I-15, I-805, US-94, SR-52, SR-163.

- Communication Infrastructure is based on fiber optics, microwave radio, coaxial, and twisted pair cable.
- System capabilities will include: real time data collection, electronic incident detection, ramp metering, mainline metering, and lane use control.
- Traffic information collection is done using inductive loops, call boxes, cellular phones, and surveillance aircraft.
- Traffic information distribution is done using DMS, HAR, telephone information numbers, and personal computers via modem and Internet.

There is no documented procedure for Incident Management. However, the Center assists in coordinating the activities and necessary response.

## Centralized Traffic Signal Control Systems

### City of San Diego

The City operates 450 signals under the Peek SCOOT system.

- Communication infrastructure is based on fiber optic, microwave radio, dial up telephone lines, and twisted pair cable.
- Signal control is based on a centralized and distributed architecture using the SCOOT and QUICNET software with model 170 controllers.
- Traffic data and information are collected through inductive loops and CCTV with VIDS.
- Traffic information distribution is done using DMS and HAR.

### La Mesa Traffic Management Center

The City operates 24 signals under a Farradyne OPAC/RT system.

- Communication infrastructure is based on fiber optic, and NTCIP.
- Signal control is based on a centralized and distributed architecture using a UTCS with OPAC-RT software with model 170 w/470I and 2070 controllers.
- Traffic data and information are collected through inductive loops and VIDS.

### Electronic Toll Collection System: San Diego - Coronado Bridge (SR-75)

The San Diego - Coronado Bridge is expected to have ETC operational by August 1997 - February 1998. The system is a tag based MFS Network Technologies and Texas Instruments system that uses overhead antennae.

## SAN FRANCISCO, OAKLAND, SAN JOSE

### Freeway Management Centers

#### Vallejo Interim Transportation Management Center

It is expected that the Coastal Region Transportation Management Center will be assuming the duties of traffic management from the Vallejo Interim Traffic Management Center in June 1996. The Vallejo Interim Traffic Management Center will then serve as a backup center in case of a natural disaster.

- System capabilities include: ramp metering.
- Traffic information collection is done using inductive loops and CCTV cameras.
- Traffic information distribution is done using DMS and HAR.

### Coastal Region Transportation Management Center

The Coastal Region Transportation Management Center serves the costal areas from Santa Barbara north to Oregon. Many of the freeways in the San Francisco, Oakland, San Jose area are equipped with surviellance equipment. It is anticipated that the Coastal Region Transportation Management Center will be assuming the duties of traffic management from the Vallejo Interim Traffic Management Center in June 1996. The Vallejo Interim Traffic Management Center will then serve as a backup center in case of a natural disaster.

- Communication Infrastructure is based on fiber optics, spread specturm radio, coaxial, and twisted pair cable.
- System capabilities will include: real time data collection, electronic incident detection, ramp metering, mainline metering, and lane use control.
- Traffic information collection is done using inductive loops, CCTV cameras, CCTV cameras with VIDS, call boxes, video imaging detectors, and service patrol.
- Traffic information distribution is done using DMS, HAR, and telephone information numbers.

### Incident Management Programs

#### Silicon Valley Smart Corridor

The Silicon Valley Smart Corridor, currently being developed, is a thirteen mile section alongRoute 17/ I-880 between Lark Avenue in Los Gatos and Route 237 in Milpitas. The project incorporates surface streets as alternate routes. The alternate routes are Bascom Avenue to the eastof the corridor and Montague Expressway - San Tomas Expressway to the west of the corridor.

#### Bay Area Transportation Management Program

The coverage are consists of appoximately 550 miles of freeway, and 1400 miles of conventional highways/expressways within the nine Bay Area Counties. The program utilizes primarily the California Highway Patrol computer-aided dispatch (CAD) system and a rapidly growing traffic operations system (TOS) to detect, verify, and clear highway incidents. The TOS includes a 24-hours/day management center, changeable message signs (CMS), highway advisory radios (HAR), closed circuit TV cameras, detection stations, freeway service patrols (FSP), and traffic management teams (TMT). The FSP consists of 20 contracts for tow service during peak commute periods on approximately 100 miles of freeway, as well as State provided tow-service on toll-bridges/tunnels 20-hours/day. Using portable CMSs and HARs to provide traffic advisory/detour information, the TMT responds only to major incidents which severely reduce the capacity of a highway (e.g. dense fog, high wind, floods, fire, earthquake, multi-vehicle/fatal accidents, jackknifed trucks, HAZMAT spills, ect). The TMT typically responds to incidents within a minimum of 30 minutes estimated duration during normal business hours, or two hours duration after-hours. The TMT's average response time is about 15-30 minutes during business hours, and 45-60 minutes after-hours. The TMT responds to an average of 300 incidents per year.

## Centralized Traffic Signal Control Systems

### San Jose Signal Central

Intersections are being brought on-line throughout the City, and the downtown area is also equipped with CMS and CCTV camera coverage. The City operates over 540 signals.

- Communication infrastructure is based on fiber optic and twisted pair cable.
- Signal control is based on a centralized architecture using the JHK Series 2000 software with NEMA TMP 390 controllers.
- Traffic data and information are collected through inductive loops and CCTV cameras.
- Traffic information distribution is done using DMS and HAR.

### Santa Clara County

The County operates over 155 signals using the Naztec system.

- Communication infrastructure is based on spread spectrum radio and twisted pair cable.
- Signal control is based on a distributed architecture using NEMA controllers.
- Traffic data and information are collected through inductive loops, radar detectors and video imaging detectors.
- Traffic information distribution is done using DMS.

## Advanced Public Transportation Systems

### Alameda - Contra Costa Transit District (AC Transit)

The agency operates over 700 buses and plans to deploy: Computer Aided Dispatching, Real-time Passenger Information, Automatic Passenger Counters, Engine Component Probes, and Silent Alarm.

#### Outreach

The system operate 15 buses using a GPS-based AVL with silent alarm system and Computer Aided Dispatching (CAD).

#### Muni

The system operate 1000 buses using a sign post AVL with silent alarm system.

### Bay Area Rapid Transit District (BART) and the Central Contra Costa County Transit Authority (CCCTA)

The Translink system is being developed and implemented by the Bay Area Rapid Transit (BART), the Oakland Metropolitan Transit Commission, and the Central Contra Costa County transit Authority

(CCCTA). This system uses magnetic stripe stored value tickets good at all of the 34 BART stations and 45 BART Express buses, as well as the 112 CCCTA buses.

San Mateo County Transit District (SamTrans)

The system operate 320 buses using a sign post AVL system.

San Francisco - Oakland Bay Bridge (I-80)

The San Francisco - Oakland Bay Bridge is expected to have ETC operational (6 miles) by August 1997 - February 1998. The system is a tag based MFS Network Technologies and Texas Instruments system that uses overhead antennae.

Carquinez Bridge (I-80)

The Carquinez Bridge was expected to have ETC operational (2 miles) by August 1996. The system is a tag based MFS Network Technologies and Texas Instruments system that uses overhead antennae.

Martinez - Benicia Bridge (I-680)

The Martinez - Benicia Bridge is expected to have ETC operational (2 miles) by August 1997 - February 1998. The system is a tag based MFS Network Technologies and Texas Instruments system that uses overhead antennae.

Richmond - San Rafael Bridge (I-580)

The Richmond - San Rafael Bridge is expected to have ETC operational (5 miles) by August 1997 - February 1998. The system is a tag based MFS Network Technologies and Texas Instruments system that uses overhead antennae.

Dumbarton Bridge (SR-84)

The Dumbarton Bridge is expected to have ETC operational (6 miles) by August 1997 - February 1998. The system is a tag based MFS Network Technologies and Texas Instruments system that uses overhead antennae.

Antioch Bridge (SR-4)

The Antioch Bridge is expected to have ETC operational (2 miles) by August 1997 - February 1998. The system is a tag based MFS Network Technologies and Texas Instruments system that uses overhead antennae.

San Mateo - Hayward Bridge (SR-93)

The San Mateo - Hayward Bridge is expected to have ETC operational (10 miles) by August 1997 - February 1998. The system is a tag based MFS Network Technologies and Texas Instruments system that uses overhead antennae.



## SCRANTON, WILKES-BARRE

### Advanced Public Transportation System: County of Lakawanna Transit System (COLTS)

The County of Lakawanna Transit System (COLTS) operates a total of 32 buses in the city of Scranton, Wilkes-Barre. COLTS has had their AutoTrac GPS-based system in operation since October 1994. They have recently implemented one of the first AVL systems for public transit in which the Vehicle Tracking Unit can initiate the "next-stop" announcement system. Designed by AutoTrac, Inc., the FleetService system includes the following: differential GPS; GPS-triggered next-stop announcement system; on-time schedule monitoring; multiple mapping stations controlled by an area network; and a replay feature to play back the movement of any bus for any given time and date. The agency is very enthusiastic about the system, citing that on-time performance has increased dramatically, that the enunciators help with ADA compliance, and that the AVL aids record keeping.

## SEATTLE, TACOMA

### Freeway Management Centers

#### Traffic Systems Management Center (TSMC)

This center operates using current electronic surveillance over 91 miles of freeway on I-5 S 170th St. to 128th St., SW 33.5 I-90 I-5 to Front Street 17.0 I-405 I-5 @ Southcenter to SR-522 11.5 SR-520 I-5 to Lk Sammamish Pkwy 23.5 SR-167 84th Ave S to I-405 5.0. The center plans to expand to a total of 90.5 miles using future electronic surveillance (planning, design, and construction) on I-5 Pierce C/L to S 170th St 13.5 I-5 128th St SW to Marysville 12.25 I-405 SR-522 to Swamp Creek I/C 6.8 SR-2 I-5 to SR-9 5.0 SR-18 I-5 to I-90 28.0 SR-167 SR-18 to 84th Ave S 7.0 SR-509 Des Moines Way to 1st Ave Bridge 5.3 SR-518 SR-509 to I-5 3.8 SR-520 Lk Sammamish Pkwy to SR-202 1.3 SR-522 I-405 to SR-9 2.5 SR-525 I-5 to SR-99 2.8 SR-526 Mukilteo to I-5 4.5 SR-599 I-5 to SR-99 1.75.

- Communication Infrastructure is based on fiber optic, coaxial and twisted pair cable, and microwave radio.
- System capabilities will include: real time data collection, electronic incident detection, lane use control changeable speed CMS, freeway entrance ramp metering, and freeway to free way metering.
- Traffic information collection is done using inductive loops, CCTV cameras, CCTV cameras with VIDS, call boxes, service patrols, and video imaging detectors.
- Traffic information distribution is done using DMS, HAR, information kiosks, cable television, commercial radio stations, telephone information numbers, and personal computer via the WWW.

### Olympic Region Traffic Systems Management Center

The current Freeway Management Center in Lakewood does not have electronic surveillance, but it has an extensive plan for 7 DMS, 5 changeable signs, data stations every 1/2 mile, 22 ramp meters, and 15 CCTV.

- Communication Infrastructure is based on fiber optic and microwave radio.
- System capabilities will include: real time data collection, electronic incident detection and verification, freeway entrance ramp metering, and freeway to freeway metering.
- Traffic information collection is done using inductive loops, CCTV cameras, CCTV cameras with VIDS, call boxes, cellular phones, CB Radio, service patrols, and surveillance aircraft.
- Traffic information distribution is done using DMS, cable television, and commercial radio stations.

### Incident Management Program: Incident Response Team

The incident response team covers 6 counties in NW Washington, Region 1, consisting of 3,600 miles of State Routes and Interstates including: I-5, I-90, I-405, SR-2, SR-20, SR-99, SR-167, SR-520. The incident rates are based on "Major" incidents. A major incident is defined to be any incident that blocks at least 1 lane for more than 1 hour. The average clearance times range from 1.5 hours for semi-trucks to 3.0 hours for fatalities (which is down from 8.0 hours before the Incident Response Team began operation). The average number of minor incidents is approximately 4,800 per year. The Incident Response Team is affiliated with the Seattle Traffic Systems Management Center. The TSMC provides the use of CCTV and loop detectors for incident verification, as well as radio dispatch for incident response and maintenance.

### Centralized Traffic Signal Control Systems

#### North Seattle Advanced Traffic Management System

The North Seattle ATMS Project is designed in order to develop a communication and information system for all jurisdictions in the area. These jurisdictions include: \* The cities of Seattle, Lynnwood, Everett, Marysville, Edmonds, Mill Creek, Montlake, Terrace, and Bothell (Regions of King and Snohomish Counties) I-5 from Seattle to Marysville including I-405, SR-99 and other adjoining State Routes \* The routes within the geographical coverage operated by Metro, Community, and Everett transit systems This coverage area applies to the first phase of the project. The design of the ATMS will be for an extended area to ensure easy expansion in the future.

The Seattle regional area is in the process of developing an Advanced Transportation Management System (ATMS) that will allow local jurisdictions to exchange transportation information. The overall goal of the North Seattle ATMS project (NSATMS) is to promote agency coordination and cooperation throughout the Seattle region in order to more efficiently manage traffic. The NSATMS is a collaboration of many cities, counties, and transit agencies. The project will marry the transit system and traffic management system. It will coordinate signals and obtain real-time data for the highway and transit

system. The primary objectives of the NSATMS Project are: (1) To develop and implement a regional monitoring and data sharing system that will allow all the jurisdictions in the area to have real-time information on traffic and transit conditions in the region. (2) To develop appropriate coordinated operations between jurisdictions to enhance the transportation network. (3) To provide a test bed and data source for all statewide IVHS initiatives.

#### City of Bellevue Traffic Control Center

The system developed by the City of Bellevue Computran Systems, controls 137 signals in the city limits of Seattle and Tacoma.

- Communication Infrastructure is based on twisted pair cable.
- Signal control is based on centralized and distributed architecture using UTCS software with NEMA controllers.
- Traffic data and information are collected through inductive loops, CCTV cameras, CCTV cameras with VIDS, and microwave detectors.
- Traffic information distribution is done using DMS.

#### City of Lynnwood

The centralized traffic signal control system in South Snohomish County serves the cities of Lynnwood, Edmonds, and Mount Lake Terrace. This system, which controls 64 signals, has WS DOT signals controlling the ramps for I-5 at 220th Street SW and 196th Street SW. The system was developed by Multisonics/IDC.

- Communication Infrastructure is based on twisted pair cable.
- Signal control is based on a centralized architecture using Multisonics software with NEMA controllers.
- Traffic data and information are collected through inductive loops.

#### City of Seattle Transportation Management Center

The center controls 875 signals in the city limits of Seattle.

- Communication Infrastructure is based on fiber optic, twisted pair cable and dial-up telephone lines.
- Signal control is based on a centralized and distributed architecture using UTCS software with NEMA controllers.
- Traffic data and information are collected through inductive loops, and CCTV cameras.
- Traffic information distribution is done using DMS.

## Advanced Public Transportation Systems

### King County Metro

The system operates 1200 buses. Metro has equipped all of its revenue vehicles with a signpost and odometer AVL system. The AVL, provided by Harris Corporation, has been operational since 1993. The system includes a silent alarm for the driver and CAD. Each dispatch station includes two computer screens with a digital map of the service area (or a user-specified subset of the area) and several automated dispatch functions, such as communications with the drivers and incident logging. In addition, the system will provide input to an FM radio station which will include real-time information on all relevant commute modes.

### Community Transit

The system operates 200 buses. Community Transit does not currently utilize any ITS technologies, however they are funded for an AVI system (probably AMTEK) that will provide traffic signal preemption capability for transit buses. This will be a transponder with an antenna that will relay information to the controller so that a determination can be made as to the priority. The preemption will aid in reduced traffic time and reliability. At this time there is no AVL capability planned, however under the planned system the location of the buses are reported at each signal. There is a 2 year horizon for deployment.

## SPRINGFIELD

Advanced Public Transportation System: Pioneer Valley Transit Authority The system operates 178 buses. The system includes: a GPS-based AVL system, transit operators software, and two-way data communication.

### Electronic Toll Collection System: Massachusetts Turnpike

The systems covers 136 miles on I-90 from NY state line to Boston. MFS Network Technologies is currently designing the close ETTM system for the Massachusetts Turnpike Authority.

## ST. LOUIS

### Freeway Management Center: MHTD Traffic Center (St. Louis)

This center operates over 134 miles of freeway on I-64/US 40 St. Charles County TO I-70 28 miles I-270 I-55 TO State Line 36 miles I-70 Muege Rd. TO I-64 25 miles I-44 SR 141 TO I-55 17 miles I-55 Exit 193 TO I-64 17 miles I-170 I-270 TO I-64 11 miles. The MHTD Traffic Center is in design and has been funded; it is expected to be completed in 1997.

- Communication Infrastructure is based on fiber optic, coaxial and twisted pair cable.

- System capabilities will include: real time data collection, electronic incident detection and verification.
- Traffic information collection is done using inductive loops, CCTV cameras, call boxes, cellular phones, service patrols, and video imaging detectors.
- Traffic information distribution is done using DMS, HAR, and electronic bulletin boards.

Incident Management Program: St. Louis Regional Incident Management Coalition

The incident management coalition responds to 20000 incidents covering I-55 I-270 TO I-64 I-270 I-55 TO West Florissant I-70 Midrivers Mall Drive TO I-64 I-170 I-270 TO I-64 I-64/US 40 I-270 TO I-70 I-44 I-270 TO I-55 with a response time of 13 minutes. The St. Louis Regional Incident Management Coalition will utilize the technologies of the MHTD Traffic Center, which should be completed in 1997.

## SYRACUSE

Electronic Toll Collection System: New York State Thruway

Currently the NYS Thruway in Syracuse does not have ETC. ETC will be install on the NYS Thruway between Albany and Buffalo by the end of 1996. The system is a Mark IV tag-based system with overhead antennae.

## TAMPA, ST. PETERSBURG, CLEARWATER

Freeway Management Center: Sunshine Skyway Bridge (I-275)

The center covers 9 miles on the Sunshine Skyway Bridge on I-275 over Tampa Bay, connecting Pinellas County to Manatee County.

- Communication Infrastructure is based on coaxial and twisted pair cable, and microwave radio.
- Traffic information collection is done using CCTV cameras, and call boxes.
- Traffic information distribution is done using DMS, commercial radio stations, and remotely operated stop lights.

Incident Management Program: Tampa Bay Area Freeway Management Team

The Team establishes procedures for clearing I-4, I-275, and I-75 in Hillsborough Count.

## Centralized Traffic Signal Control Systems

### Pinellas County

The system developed by Computran controls 280 signals in all of Pinellas County which is not in St. Petersburg or Clearwater.

- Communication Infrastructure is based on twisted pair cable.
- Signal control is based on a centralized architecture using UTCS software with NEMA controllers.
- Traffic data and information are collected through inductive loops.

### City of St. Petersburg

The system developed by Computran controls 285 signals in the city of St. Petersburg.

- Communication Infrastructure is based on leased telephone lines.
- Signal control is based on a centralized architecture using UTCS software with NEMA controllers.
- Traffic data and information are collected through inductive loops.

### City of Tampa

The system developed by Computran controls 500 signals in the city of Tampa.

- Communication Infrastructure is based on fiber optic and twisted pair cable.
- Signal control is based on a centralized architecture using UTCS software with NEMA controllers.
- Traffic data and information are collected through inductive loops.

### City of Clearwater

The system developed by Computran controls 130 signals in the city of Clearwater.

- Communication Infrastructure is based on twisted pair cable and leased telephone lines.
- Signal control is based on a centralized architecture using UTCS software with NEMA controllers.

- Traffic data and information are collected through inductive loops.

Advanced Public Transportation System: Hartline

The system operates 175 buses. The system includes: a GPS-based AVL system, a silent alarm system, and two-way data communication.

Electronic Toll Collection System: Florida Turnpike

The ETCS covers a total of 54 miles: Tampa - 53.8 miles: Tampa Crosstown Expressway (SR 618) - - Gandy Blvd to I-75 - - 12.9 miles Veterans Expressway (TR 589) - - SR 60 to SR 597 - - 14.9 miles Pinellas Bayway (SR 682) - - St. Petersburg to Mullet Key - - 14.9 miles Sunshine Skyway Bridge (I-275) - - St. Petersburg to Terra Ceia - - 11.1 miles. The Florida DOT, Turnpike District plans to implement the "SunPass" system on the entire Florida Turnpike. Alligator Alley (I-75) and other toll routes in Miami, Tampa/St. Petersburg, and Orlando under the jurisdiction of the Florida DOT Turnpike District are also expected to be equipped with the SunPass System. This will be an RF AVI/ETTM system with "read-write" interactive capabilities and controlled by a central computer. The transponder will carry all account information and could be capable of receiving information on traffic conditions. The antennae will either be overhead or lane side. This type of system has the potential for use in tracking vehicle movements to determine travel speed and congestion conditions on area highways. The first phase of implementation is expected in southeast Florida around December, 1997. The second priority is in Orlando approximately one year later. Eventually the entire Florida Turnpike and the other toll roads in the coverage area will be operating the SunPass System, making it one of the world's largest AVI/ETTM systems.

## TOLEDO

Centralized Traffic Signal Control System: City of Toledo Signal System

The system developed by Data General controls 540 signals in the 84 square miles of the Toledo city limits.

- Communication Infrastructure is based on twisted pair cable and microwave radio.
- Signal control is based on a centralized architecture with NEMA controllers.
- Traffic data and information are collected through inductive loops.

## TUCSON

Centralized Traffic Signal Control System: Transportation Management Section - The system developed by JHK & Associates controls 320 signals in the Tucson Metropolitan Area, extending beyond the city limits in some areas to bring State and County controlled signals into the system.

- Communication Infrastructure is based on fiber optic, twisted pair cable, and microwave radio.
- Signal control is based on a distributed architecture using UTCS and RHODES software with NEMA and Type 170 and 2070 controllers.
- Traffic data and information are collected through inductive loops, video imaging detectors, DMS, and cable television.

#### Advanced Public Transportation System: Sun Tran

The system operates 200 buses. Rockwell is designing a custom interface which will incorporate the new AVL and other technologies. This system will tie in with the existing scheduling and routing system. The transit system may be linked with the new centralized signal control center. Due to be complete by 6/97: Passenger information system 40 vehicles with voice enunciation system 200 vehicles with AVL and two-way data communications Automated telephone help service Planned: Multiprovider trip reservation and integrated billing system. (Paratransit) Integrated fare media Automated demand responsive dispatching.

## TULSA

#### Centralized Traffic Signal Control System: Downtown Traffic Signal System

The system initially developed by Sperry controls 90 signals within the Central business district with some signals on the CBD fringe.

- Communication Infrastructure is based on twisted pair cable.
- Signal control is based on a centralized and distributed architecture with using UTCS software with NEMA and Type 170 controllers.
- Traffic data and information are collected through inductive loops.

## Electronic Toll Collection Systems

#### Creek Turnpike

The ETCS covers a total of 7 miles from US 75 to US 64. The open system is an Amtech tag-based system with overhead antennae.

#### Will Rogers Turnpike

The ETCS covers a total of 88 miles from Tulsa to the Missouri State line. The close system is an Amtech tag-based system with overhead antennae.



## Muskogee Turnpike

The ETCS covers a total of 34 miles from SR 51 east of Broken Arrow to SR 165. The open system is an Amtech tag-based system with overhead antennae.

## WASHINGTON, DC

### Freeway Management Centers

#### I-66/I-95/I-395 Traffic Management System

Currently the system covers 32 miles on I-66, I-95, I-395. TMS is being extended 20 miles on I-66 and 20 miles on I-95.

- System capabilities will include: real time data collection, ramp metering, and incident management.
- Traffic information collection is done using inductive loops, CCTV cameras, CB radio, surveillance aircraft, and service patrol.
- Traffic information distribution is done using DMS, HAR, and cable TV.

#### SHA Traffic Operations Center (TOC-3) College Park

Current coverage with current deployments: 400 miles Capital Beltway (I-495 & I-95), I-270, US 50, US-29, MD-295 and various arterials around the Washington, D.C. metropolitan area. Current deployment is loose (i.e. equipment is far apart) Future coverage with future deployments: 400 miles same routes as current coverage with much closer deployment of equipment (1/2 - 1 mile detection spacing and 1 - 2 mile CCTV spacing on some routes and interstates.

- Communication Infrastructure is based on fiber optics and leased telephone lines.
- System capabilities will include: real time data collection, electronic incident detection and verification, and incident management.
- Traffic information collection is done using inductive loops, CCTV cameras, cellular phone, CB radio, wide area radar detector, and service patrol.
- Traffic information distribution is done using DMS, HAR, and telephone information numbers, commercial radio stations, and information kiosks.

#### Northern Virginia Transportation Operations Center

The Center's coverage expands on I-66 between Theodore Roosevelt Memorial Bridge and Gainesville, VA; Henry G. Shirley Memorial Highway (I-395) between I-495 and the 14th Street Bridge; Capital Beltway (I-95/I-495).

Operational since July 1994 Airborne Video System operated by the Fairfax County Police Department establishes communication between surveillance helicopter and VA DOT's Northern Virginia TOC particularly for incident management. The annual operating budget is \$2.3 million combined for the Northern Virginia Transportation Operations Center and the I-66/I-95/I-395 Traffic Management System.

- Communication Infrastructure is based on fiber optics, microwave radio, coaxial, and twisted pair cable.
- System capabilities will include: real time data collection, electronic incident detection and verification, incident management, lane use, and ramp metering.
- Traffic information collection is done using inductive loops, CCTV cameras, CCTV cameras with VIDS, cellular phone, CB radio, call boxes, surveillance aircraft, and service patrol.
- Traffic information distribution is done using DMS, HAR, and telephone information numbers, commercial radio stations, and cable television.

### Centralized Traffic Signal Control Systems

#### Montgomery County Advanced Transportation Management Center

The County operates over 650 traffic signals using an Automatic Signal/Eagle Signal and Orbital Science system design. The county's transit system (Ride On) dispatching operation and their information center is co-located with the traffic management and control facility. This was done to improve coordination between traffic engineering and transit services, and ultimately, to ensure the efficient utilization of transportation capacity in the county.

- Communication infrastructure is based on fiber optic.
- Signal control is based on a centralized architecture using a UTCS software.
- Traffic data and information are collected through inductive loops, CCTV cameras, and video imaging detectors.
- Traffic information distribution is done using DMS, HAR, and cable television.

#### Northern Virginia Traffic Signal System

The system operates over 800 signals in Fairfax, Loudoun, and Prince William Counties.

- Signal control is based on a centralized architecture using a UTCS software with NEMA and model 170 controllers.
- Traffic data and information are collected through inductive loops.

### Washington DC Traffic Signal System

The system developed by Dynalectric operates over 1350 signals in Washington D.C.

- Communication infrastructure is based on twisted pair cable.
- Signal control is based on a centralized architecture using a UTCS software with model 170 controllers.
- Traffic data and information are collected through inductive loops, and microwave detectors.

### City of Alexandria Traffic Signal System

There are 215 signalized intersections maintained by the City of Alexandria, of which 148 are centrally controlled using a system developed by Sperry.

- Communication infrastructure is based on twisted pair cable.
- Signal control is based on a centralized architecture using a UTCS software with NEMA controllers.
- Traffic data and information are collected through inductive loops, and microwave detectors.

### Advanced Public Transportation Systems

Washington Metropolitan Area Transit Authority (WMATA) Metro Bus The system operates over 1300 buses using an integrated fare media, electronic and automated trip payment, and automatic enunciation system.

### Ride-On

Montgomery County is the site of the pilot program for the nation's first fully integrated transit and traffic management system for its Ride-On buses and traffic operations. All 250 public transit

buses are being equipped with GPS-based AVL technology from the Orbital Sciences Corporation. Using this technology, Montgomery County DOT officials are able to track these buses as they move through the County, and integrate that information with traffic signal operations to give buses priority treatment when necessary. The vehicle location data are transmitted from the buses by radio transmission to the Advanced Transportation Management Systems Control Center, where it is received by a computer. Using control software, the received information is translated and displayed graphically on a monitor, indicating the location of each vehicle at the time of data transmission. Data transmission will occur on a regular cycle. From the graphical display, traffic management staff can manually adjust signal timing, if necessary. If a bus is running late, the software algorithm in the bus computer request priority movement as it approaches an intersection with a traffic signal. The traffic manager reviews the scenario to see if the traffic flow can be adjusted. Once the bus is through the intersection, it will send a message saying "Intersection Clear," so that the traffic manager can stop the signal

cycle lengthening. Presently, 15% of Montgomery County commuters use Ride-On buses. As the vehicle tracking and management software systems are perfected, improving reliability and convenience of service, the County hopes to increase the number of bus commuters to 20 percent."

#### Potomac and Rappahannock Transportation Commission

Of the 75 buses, 22 are used for suburban transit service called OmniLink. All the OmniLink buses have GPS based automatic vehicle locators and two-way data communication capabilities. The flex-route operations provided by OmniLink allow riders to request in advance for an OmniLink bus to pick them up in their neighborhood.

### Electronic Toll Collection Systems

#### Dulles Toll Road

Dulles Toll Road (SR-267) is a 13 mile facility from SR-28 to I-495. This project is called FASTOLL. Electronic toll collection (Mark IV) are being installed and are partially operational.

#### Dulles Greenway

This is a 14 mile extension of Dulles Toll Road from Dulles Airport to Leesburg. There are currently 4 interchanges in use for toll collection, and 2 more are planned in the future. There is also 1 central toll plaza. The system is a Mark IV, tag based system with overhead antennae.

#### West Palm Beach, Boca Raton, Delray

##### Centralized Traffic Signal Control System: Palm Beach County Traffic Control Signal Center

The Center operates over 380 signals within the geographic boundaries of Palm Beach County.

- Communication infrastructure is based on fiber optic and twisted pair cable.
- Signal control is based on a centralized architecture using a UTCS software with NEMA controllers.
- Traffic data and information are collected through inductive loops.

##### Electronic Toll Collection System: Florida Turnpike

The Florida DOT, Turnpike District plans to implement the "SunPass" system on the entire Florida Turnpike. Alligator Alley (I-75) and other toll routes in Miami, Tampa/St. Petersburg, and Orlando under the jurisdiction of the Florida DOT Turnpike District are also expected to be equipped with the SunPass System. This will be an RF AVI/ETTM system with "read-write" interactive capabilities and controlled by a central computer. The transponder will carry all account information and could be capable of receiving information on traffic conditions. The antennae will either be overhead or lane side. This type of system has the potential for use in tracking vehicle movements to determine travel speed and congestion conditions on area highways. The first phase of implementation is expected in southeast Florida around December, 1997.

The second priority is in Orlando approximately one year later. Eventually the entire Florida Turnpike and the other toll roads in the coverage area will be operating the SunPass System, making it one of the world's largest AVI/ETTM systems.

## Wichita

Electronic Toll Collection System: Kansas Turnpike

The Kansas Turnpike Authority operates electronic toll collection (ETC) on the entire length of the Kansas Turnpike. This closed ticketed system, and Amtech Intellitag 2000, was installed in October 1995. To date there are between 42,000 and 43,000 in-vehicle transponders in operation, and 16%-20% of the revenue is from ETC.

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